73

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JULY 1976
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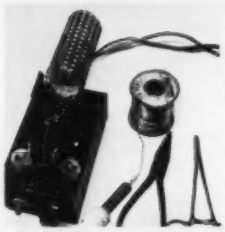

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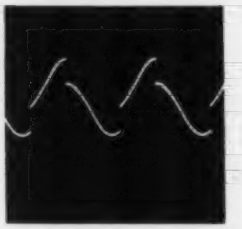

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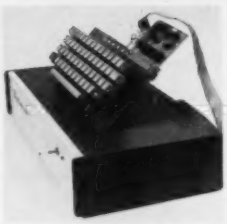

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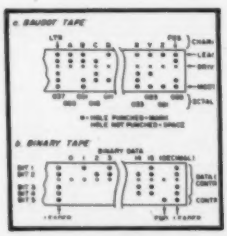

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EDITORIAL BY WAYNE GREEN

THE GOOD
THE BAD
THE UGLY

What with the Fourth of July, the bicentennial and other red, white and blue stimuli, I'm given to paying some attention to the number of bicentennial callsigns I'm not hearing on the bands. Tsk.

Yes, I know all about the bad aspects of our country ... the incredibly awful conditions, seemingly without solution, in parts of New York City ... the IRS ... the prison system (if the word "system" is adequate) ... the inability of our schools to teach ... there are many outrages and frustrations and, unless you have a way to put things into perspective, they can bring you down. Our news media are certainly no help, with their dwelling on death and destruction to cater to our morbid fascination with these things.

For all the problems we have in this country, where else would you rather live? If you are very much traveled you have reached the same conclusion I have ... for all its problems, the U.S. is by far the best. I think I liked it a bit better when I was young and when we had only about half as many people ... and cities were about one fourth their present size ... and hot dogs were a nickel. The dreams of youth.

But a country is not its geography – it is its *people* and we have *great* people. Yes, I know, we have some rotten people, too ... I moved to New Hampshire from New York City, didn't I? We have a sprinkling of sour people around us ... even on our ham bands ... but we try to avoid them as much as we can. The general impression you get in listening to the amateur bands is one of friendliness and good cheer ... heck, we even hear that attitude on CB these days, just to show how things can change.

My message is this: Resist the outrages and back the good things. Use your bicentennial callsign proudly ... we have a great country and we can make it a lot better if we join those working towards improving it and resist those trying to tear it down.

When you see the courts refusing to acknowledge the Constitution, raise hell. When Ma Bell grinds some poor bastard into the dust just because he can't afford to fight ... raise hell. We can cure many of the outrages we now accept with a shrug ... and thank heavens they happened to someone else and not us ... if we stop looking around for someone else to stand up and say NO! If something needs stopping, get busy and see what you can do about it ... get some friends to help ... write letters to the newspapers, television stations ... picket ... arrange a media event ... write your congressman ... raise hell and put a brick under it. Be a troublemaker and be damned proud of it.

Our country was not started by sheep ... those men were troublemakers ... and look what they've done! Note that they were constructive troublemakers, not fanatics ... we don't have to tear things down to make them better – we have to build and improve them. Bombing Ma Bell won't make for better or cheaper service ... letters to Congress about Bell outrages will ... etc.

A lot of people put me down because I speak out ... I'm called a radical ... but I often wonder how far to the right people must be who see me as radical! I'm accused of tilting at windmills ... and I smile at that because it does prove that I am at least trying to get something positive done while my critics are doing nothing but being destructive.

When people get power they have a strong tendency to abuse that power ... and that holds for big business, for government officials and for labor leaders. I feel that the strength of our country lies in our ability to fight against powerful people bent on doing bad things. The most serious weakness we have is the ability of many (if not most) people to put up with these bad things and not raise hell about them.

The number of bad things happening is almost overwhelming at times. It would be most discouraging if we could not compare our situation with other countries ... where we find that most have it a lot worse. Since our news media tend to stress disasters, we are not much in the habit of thinking in terms of the good things which are going on ... pity, for though these things are not "news," they more than overshadow the miseries.

In amateur radio we have some bad guys and a whole lot of good guys. The good guys are organizing and running traffic nets, eyebank nets, emergency nets, DXpeditions, repeaters, clubs which are teaching new hams our hobby, hamfests ... and they are experimenting with new techniques of RTTY, slow scan television, moonbounce, Oscar operating, computers, new antennas ... etc. The bad guys are trying to louse up nets, spoil contacts with interference, make DX pileups a mess, organize repeater wars, keep AM alive on 75, jam RTTY or SSTV transmissions, etc.

You know what I do when I hear some ass proving he is one on the air? I go ahead and tell him what I think of him and the lousy things he is doing. Oh, this makes me some enemies, no doubt about that ... but they are enemies I am proud of and point to with pride. I don't think you'll hear many bad guys claiming friendship with Wayne Green ... nor many good guys giving me the bad mouth. I would not want as friends those enemies of whom I am aware.

So much for the soapbox this July ... now, about those bicentennial callsigns. I want to hear all you good guys out there using them ... proud of the best aspects of our country and the things we have accomplished. Let's look on those callsigns as advertisements for the United States ... and as promises to do everything we can to make it better ... to put ourselves on the line to fight as best we can the bad things ... the arrogance of big business ... of government. When something is wrong let's stamp our foot and try our very best to make it right. It is not easy to stick up for your rights ... particularly when everyone else is shuffling around uneasily, trying to figure out how to avoid trouble.

Troublemakers started our country ... and they will keep it strong. It is sometimes absolutely amazing what one troublemaker can do. One lone troublemaker managed to get parking meters outlawed for an entire state! Most of the time the entrenched power of government officials is tough to fight, but each has his weak points and you can find them. They either are appointed or elected, and this means you may be able to get in your licks at re-appointment time or re-election time ... if all else fails.

The Watergate mess has weakened the power grip of many government agencies on us ... the FBI, CIA, DIA, IRS, and such ... but they will build it up again unless we keep the pressures on them. They got much of their power in order to help them fight organized crime; instead, they leveled the power at the less powerful ... us, the unorganized citizens ... and left the powerful organized crime

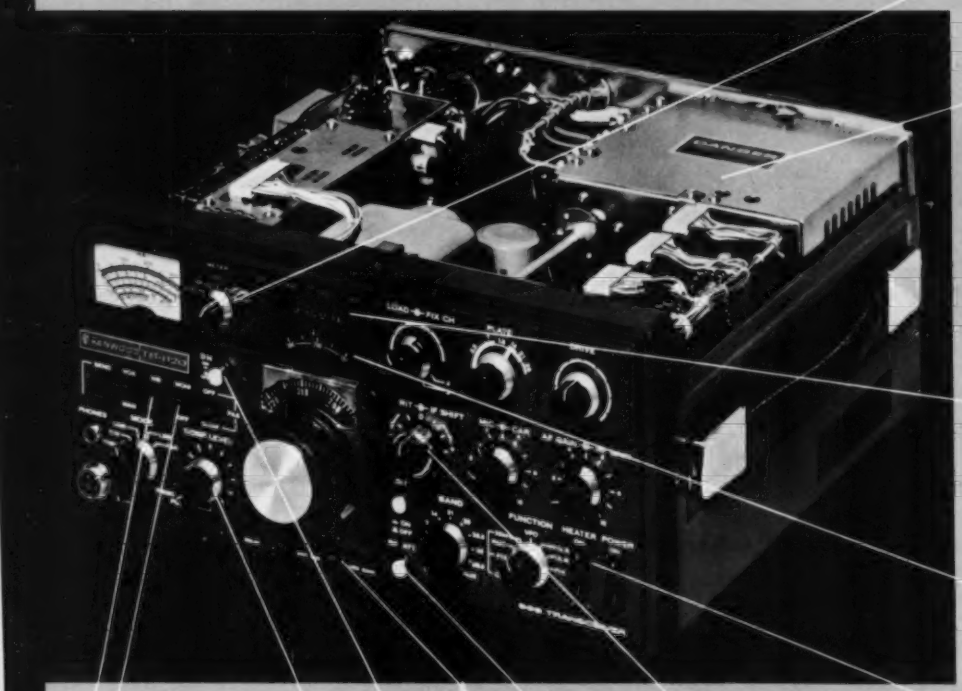
Continued on page 6

KENWOOD'S TS-820 *the Pacesetter*

LIMITED QUANTITIES AVAILABLE IN JULY

Kenwood's well deserved reputation for fine craftsmanship and superb performance has never been more evident than in the TS-820. As a result of a host of innovative features being brought together, the 820 offers a degree of versatility, performance and pleasure second to none.

The Kenwood TS-820 is destined to be the world's new standard of excellence in amateur radio for years to come... a true "Pacesetter".



Features

PLL • The TS-820 employs the latest phase lock loop circuitry. The single conversion receiver section performance offers superb protection against unwanted cross-modulation. And now, PLL allows the frequency to remain the same when switching sidebands (USB, LSB, CW) and eliminates having to recalibrate each time.

FULL METERING • During receive, an easy to read meter functions as an S-meter. The same meter displays ALC level, plate current, RF output, and plate voltage during transmit. Includes COMP setting for adjusting the compression level of the built-in speech processor.

FINAL AMPLIFIER • The TS-820 is completely solid state except for the driver (12BY7A) and the final tubes. Rather than substitute TV sweep tubes as final amplifier tubes in a state of the art amateur transceiver, Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity. The input power of the TS-820 is conservatively rated at 160 W DC, 200 W PEP. Tubes run cool with the aid of a noiseless fan (standard) mounted on the rear panel. The above tube and power combination minimizes the possibilities of TVI and helps to maintain the Kenwood reputation for excellent audio quality.

DIGITAL READOUT DG-1 • (optional) A digital counter display can be employed as an integral part of the VFO readout system. Counter mixes the carrier, VFO, and first heterodyne frequencies to give *exact* frequency. Figures the frequency down to 10 Hz and digital display reads out to 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

DRS DIAL • Includes the same satin-smooth planetary drive found on other fine Kenwood models plus special, high-precision gears to add a new "monoscale" feature for easier frequency readout. LSB, USB, and CW operating frequencies can be accurately read from the same pointer.

HEATER SWITCH • The filaments of the three vacuum tubes may be turned off during periods of "receive only".

CW AUDIO CHARACTERISTICS • During CW reception, a special filter is used to alter the audio frequency response to provide a more comfortable, easy to copy tone.

Other features include:
- Built-in 25 kHz calibrator*
- Built-in speaker*
- CW Sidetone and semi-break in*
- Rear panel terminals for linear amplifier, IF OUT, RTTY, and XVTR.
- Handy phone patch IN and OUT terminals*

*Also available, the VFO-820... the perfect companion to the TS-820.

NOISE BLANKER • The TS-820 uses an efficient noise blanker circuit, another Kenwood exclusive. A special crystal filter assures unsurpassed efficiency in eliminating unwanted pulse noises.

RF MONITOR • Built-in monitor circuit allows you to hear your own voice by sampling the RF signal. Especially useful for adjusting the RF Processor.

HIGH STABILITY VFO • The VFO, heart of any SSB transceiver, is an exclusive Kenwood design using FET technology.

DIGITAL HOLD • A single pushbutton switch offers the operator unprecedented versatility. The digital hold circuit will lock the counter and display at any frequency, but will allow the VFO to tune normally. Ever wanted to return to a certain spot on the band and forgotten the frequency? That won't happen again with the new digital hold feature on the Kenwood TS-820.

SPEECH PROCESSOR • An HF circuit provides quick time constant compression using a true RF compressor as opposed to an IF clipper. Amount of compression is adjustable to the desired level by a convenient front panel control.

IF SHIFT • The IF SHIFT control varies the IF passband without changing the receive frequency. This "IF shift" control is located on the front panel and provides excellent unwanted signal reject control or "pass band tuning." The 820 moves the signal across the IF pass band not the pass band across the signal.

RF ATTENUATOR • Easy, one touch activation of the attenuator supplies 20 dB of padding on receive.

VOX • A voice-activated microphone circuit is built into the TS-820 with VOX GAIN, ANTIVOX, and VOX DELAY controls placed on the front panel for convenient adjustment any time.

TRIO-KENWOOD COMMUNICATIONS INC.
116 EAST ALONDRA/GARDENA, CA 90248

KENWOOD
...pacesetter in amateur radio

EDITORIAL BY WAYNE GREEN

from page 4

people alone. The results were devastating at times. With a few more troublemakers like those *Washington Post* reporters who blew the whistle on the whole rotten situation, our country will move ahead and get better, little by little.

WAYNE AT ATLANTA

Plans have been made for a one hour "*73* Forum" at the Atlanta HamFestival on Saturday, June 12th. In order to make candid questions and answers possible, I will ask that no recorders be used. There are a great many things going on in and around amateur radio that are being kept a secret from most amateurs, and one of the major reasons why I am prohibited from speaking at most ARRL conventions is that I tell it like it is. Note that the Denver ARRL Convention was forced to cancel my invitation to speak this year because of fear of what I might reveal.

What effect will the current craze for CB have on amateur radio? And what will be the impact of microcomputers on amateur radio? I'll try to put these into perspective for you. In addition, please bring all of the Wayne Green haters you can to the forum and have them ask me about the things they object to that they think I've done. I won't object to some Wayne Green fans, if any can be found on this short notice, just so I won't feel like I'm all alone. If you are not pro or con Wayne Green, please go somewhere else . . . I want to talk with people who at least *care* about amateur radio and if my editorials haven't gotten you either enthused or furious you are so deeply apathetic that you are beyond my help.

AMELIA

My *TV Guide* reveals that Hollywood is working on a three hour TV movie about Amelia Earhart for next season. Since she has been mentioned in the Ancient Aviator, this is timely.

Some years ago, when the book on Amelia came out, I mentioned the curious set of coincidences which enabled me to have heard much of what the book's author spent years trying to find out. For instance, the chap who set up Amelia's plane with the special engine and fuel tanks so that she could take pictures of Truk for our government was a good friend of my father's and I heard about the project shortly after her disappearance.

Truk was a major Japanese naval base at the time and the U.S. wanted desperately to know what was going on there. The whole 'round the world flight of Amelia's was a cover for the one leg where she would zig up and fly over Truk, taking pictures, and then get back on her published route again as if nothing had happened. In order to cover the extra miles involved without losing too much time, she needed a more powerful engine and extra wing tanks.

She apparently made it over Truk okay, but got lost trying to find Howland Island and ended up at Majuro in the Marshall Islands, according to the book. I made two one month rest stops at Majuro between submarine war patrols during WWII, and heard word there of her landing, visit and eventual pickup by the Japanese. They claimed she and the chap with her, who was hurt in the crash, were taken to Saipan.

When I visited Saipan a few patrol runs later, Amelia was mentioned again and the story was that both she and Fred Noonan had died and been buried there. The author of the book came up with the same story, but he had a hard job getting it. Apparently a lot of people are still trying to cover up the Truk overflight. Weird.

You may be sure I'll be interested in seeing the movie on television when they show it later this year.

73 GETS BEST AUTHORS

Several readers have asked why it is that *73* seems to always get the best articles. The answer is not complicated . . . just put yourself in the shoes of an author who has put a lot of work into a project and has written it up for publication.

You want two major things from your article . . . first, you want to reach the largest possible readership . . . hopefully with a good percentage interested in building. Secondly, you want to be reasonably paid for your effort . . . it's only fair.

That sort of narrows the choice down to one magazine . . . *73*. *QST*, the *only* other ham magazine with a substantial readership, doesn't pay for articles . . . and doesn't have all that much readership interested in home building. *QST* reflects the interests of its readers and is only third in the number of construction projects.

While prestige is not always of paramount importance, it is a nice plus . . . and being published in the largest ham magazine is a feather in anyone's cap. It doesn't hurt at all when job hunting is in season to have a few articles you can point to.

Unfortunately, it is getting more and more difficult to have an article accepted for publication in *73* . . . you can see more and more of our rejected articles in the other ham magazines. We don't always get first pick, but most of the time we do. Right now we have a big need for microprocessor-oriented material and digital construction projects. We're always interested in state of the art techniques and new products articles. What have you?

EXAMS WANTED

It has been over a year since we've gathered a set of the FCC exams and we would like to update our collection. This helps us make sure that our license study guides are in every way up to date. Since the FCC can't send out copies of the tests, we have to depend upon readers. It is a bit of a bother, so we'll offer $5 for each different test copy we receive. Novice and Tech exams are the easiest to get, followed by the conditional exams. Since the conditional tests are a bit more difficult than those given at FCC offices, they will be particularly helpful. Let me clarify that offer . . . $5 for each exam that is different for us. We will keep the exams confidential . . . they will be used just for checking study material.

AMATEURS TEST EMERGENCY LOCATING SYSTEM

A test was run recently via Oscar 7 to determine the feasibility of using a satellite repeater for emergency locating of lost people. The test, using a low powered transmitter (under one Watt), indicated that the system was quite workable, and a rough location of the transmitter was determined by processing the Doppler shift of the signal. The test gave the location of the emergency transmitter within about 7 miles. With a little experience, the system could be made to work using transmitter powers of about 100 milliwatts, and locations within two to four miles are expected.

Think of the ramifications of this work! A tiny transmitter about the size of a matchbox could give us the approximate location of any lost person anywhere in the world . . . at sea drifting, in the desert, or perhaps in the mountains. How long before a channel is set up for this service? And then how long before the matchbox rigs are available . . . probably with one chip and a battery. A few more tests will indicate how much antenna is needed . . . a simple whip may do, but it is more likely that one of those small umbrella dish reflectors will give the amplication needed.

Amateur radio again is in the forefront of important technical developments in communications.

PHONE CALLS

Phone calls to *73* . . . please try not to. As bad as the mail is, try to use what is left of the postal service. On subs and address changes please hold tight for at least six weeks before getting nervous . . . our computer is still over 50 miles away and it takes ages to make changes or find out what is happening. Dotty is here to help from about 9-4 Eastern time weekdays. Please do not call except during our business hours . . . and leave us alone on weekends except in the case of really serious emergencies. We are not very friendly to the chap who calls from California at midnight Saturday and explains that, gee, it is only 9 o'clock out there. If you must call – (603) 924-3873.

Dennis O'Brien WB6CBJ/5 uses his new IC-202 portable, establishing a Corpus Christi first by operating "elephant mobile." Dennis, a native of California, is presently in flight training at the Corpus Christi Naval Air Station.

be my guest

visiting views from around the world

Tornado Alert

Radio and television programs are cut short by a special tornado watch bulletin issued by the National Weather Service at Dress Regional Airport.

At his home on Seib Road near Daylight, Hal Wilson moves away from the television to a radio which he and about 120 other members of Tri-State Emergency Net (network) are licensed to operate.

Several members activate radios in their homes and begin talking to one another. The instructions are clear. The amateur radio operators head outside to observe weather conditions and watch for a funnel cloud.

"I've sat up until midnight, 1, 2 in the morning with the fellas trying to sight a storm," says Wilson, an administrative supervisor with Keller Crescent Co. in Evansville.

When a funnel cloud is sighted by one of the radio operators, they use a private number to notify weather service officials immediately. In turn, the weathermen can verify a funnel cloud report by contacting one of the radio operators.

The radio operators are part of a larger group of residents in the Tri-State who volunteer their time as "spotters" for the weather service.

The procedure for sighting funnel clouds and alerting the public has become more sophisticated with the use of licensed radios, weather radar, special high frequency VHF M commercial radio weather stations which broadcast at 162.55 megahertz and switch on automatically with a special signal, and satellites 22,500 miles above earth which take pictures of the earth's surface for weather evaluation.

But even with all the equipment which makes possible more accurate and timely warnings, people are still killed by tornadoes.

Last year alone, there were 917 tornadoes in the United States which claimed 59 lives, according to the National Oceanic and Atmospheric Administration. Indiana, which accounted for 23 of those tornadoes, had no tornado related deaths in 1975.

Roland Guy Loffredo, meteorologist-in-charge at the National Weather Service here, points out that Indiana, Kentucky and Illinois are nearing the period – April and May – when maximum tornado activity has traditionally occurred.

Loffredo says the idea of a "tornado season" is a myth, because tornadoes can occur anytime warm, moist tropical air from the Gulf of Mexico clashes with cold, dry air moving down from Canada.

Typically though, those weather systems clash as seasons change when the earth shifts on its axis and the sun moves from the southeast toward the northwest. For example, Loffredo says that in the very early part of the year the greatest chance of tornadoes is in Florida. By April and May, the chance of tornadoes is great in the Tri-State and by June, areas of Northern Indiana, Northern Illinois and Wisconsin traditionally face the greatest risk of tornadoes.

Tornadoes average about 5 to 10 minutes on the ground. Most leave a path no more than an eighth of a mile wide by two to five miles long. Forward speed averages about 30 miles an hour, but may reach as much as 70 miles an hour.

"As a concentrated force," Loffredo describes tornadoes as the "most powerful of storms." Some of the worst tornadoes occurred on Palm Sunday, 1965, when about 50 twisters slammed into five states, including Indiana, and killed 256 Midwesterners. In 1925, a single tornado tore through parts of Missouri, Illinois and Indiana killing 689 persons.

In recent years, many lives have been spared due at least in part to an improved reporting system.

Weather officials say one of the most destructive tornadoes of all time hit Omaha, Neb., last May 6. More than 2000 homes were damaged or destroyed and property damage was estimated in the hundreds of millions of dollars.

Despite the vast amount of damage, there were only three deaths, and an Omaha newspaper headlined a story: "It could have been worse; but tornado alert worked."

Dale McConnaughay

Reprinted from The Evansville Press *(Ind.), March 18, 1976.*

HAM HELP

Please add me to your list for help with obtaining my license. I will need help in Germany as I will be arriving there on or about 10 July 1976. Telephone number will be Hldg Mil 7565.

Keep up the good work with the magazine, as I thoroughly enjoy reading each and every issue. As you can see from the enclosed request I am finally going to have to get a subscription.

SFC Edwen K. Gause
HQ, USAREUR & 7TH Army,
DCSOPS (FPD-FAB)
APO New York 09403

This note is to say what a fantastic magazine you and the staff put together, and ask for some Ham Help. *73* is responsible for my rebirth into ham radio after a Novice license expired in '66 due to the discovery of girls. After finding a copy of *73* at the local newsstand, I got off my duff and got another Novice, and am now heading for my General via *73*'s *Study Guide* and code tapes – Ken Sessions' book makes theory crystal clear and easy to learn.

Now for the help. I've got a Harvey Wells R9A receiver with no manual or schematic . . . so if you can't tell me where I might find one, please run a Ham Help asking for a chance to buy or borrow one for copying.

Thanks for presenting an alternative viewpoint for the ham who isn't "League", oriented, and keep that great magazine rolling off the presses.

Greg Magarie WN1VIL
58 Wyman St.
Arlington MA 02174

Please include me as a Ham Helper for anyone who wants his Novice, Technician or General ticket.

Kevin C. Potter WA6DNW
646 Fairview Ave. Apt. 7
Arcadia CA 91006

Please add my name to your list of Ham Helpers.

I hold the amateur Extra, Restricted Radiotelephone Permit, C.A.P. ticket, C.B. license and am studying for the Commercial 2nd Class. I am Club Trustee and President. I work 20 meters CW about 95% of my time on the air. My equipment lets me operate on 80, 40, 20, 15, 10, 6, and 2 meters.

The Siouxland Amateur Radio Club meets every Wednesday night, 7:00-9:30 pm. We have 41 members, many of whom came from the CB bands when they found out how much more fun they could have with the amateur license. All will have passed the code test before you get this. Some members drive over 50 miles each way.

Our club is ready to help anyone who is really ready to study and not just expect it to be handed to them. We have found it takes from 3 to 7 weeks to get the code up to about 7 wpm, depending on how badly the license is wanted.

For any help or information, please contact me.

Neil Prather WBØCQU
2215 Douglas St.
Sioux City IA 51104
(712)-277-3989

I need help with re-learning the code and brushing up on some theory, and I'm willing to trade some physical work around your shack for some technical assistance.

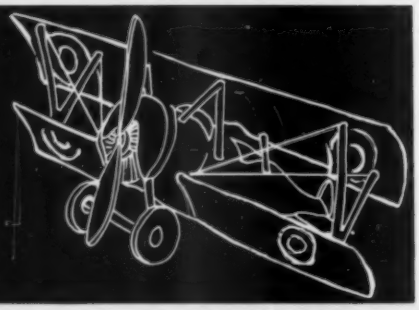
Robert Hilton
2746 Astro St.
Alexandria VA 22306

I need a dual gang 365 pF variable capacitor. It is for QRP use, so it must be small. I would appreciate anyone's help in finding one.

Gregory Danzker WN2ZDV
4000 Old Post Road
Seaford NY 11783

Autobiography of an Ancient Aviator

W. Sanger Green
1379 E. 15 Street
Brooklyn NY 11230



Amelia

When I put the cover on my typewriter last month, I had just returned from a 25 day swing around the country on an inspection tour of the more active airports. All but 3 of the 14 airports visited were city-owned; some were city-operated and some were leased to private operators. All had money problems, and nearly all had high tension wires on at least one approach to the field. I have a copy of my lightly padded expense account for the trip, which totaled $610. That included all transportation, meals, hotels, entertaining, etc. That was in 1929 when waiters, no matter how insulting they might be, would only get a 10% tip.

Now I had to get down to the business of changing a small flying field into an airport. The Ludingtons had already engaged the Airport Development and Construction Company of Philadelphia to do the engineering part of the job. My part was to tell A.D.C. what we wanted and where we wanted it, to keep a check on materials and workmanship, to approve designs and layouts, and to generally supervise the job. There was a small dirt floor hangar already on the field, with a lean-to which served as an office during the construction period.

There is nothing very exciting about building an airport, so I'll spare you the details. It took nearly a year to complete Central Airport, which included two hangars with lean-tos for shops and offices, a combination administration and station building, boundary lights, a beacon light tower, a BBT floodlight for night landings and two paved runways. In order to provide extra income, we built a public swimming pool and a miniature golf course, and leased a corner lot for a gas station.

When I got back from my survey trip around the country on February 8th, I learned that Bob Hewitt, General Manager and Chief Pilot of the Ludington Philadelphia Flying Service, had been critically injured in an automobile accident a few days before. So I made myself available to pinch hit for Bob on any flying jobs when they needed help. The Flying Service had quite a stable of airplanes: a clipped wing Waco 9, 3 Waco 10s with different engines, a Fairchild FC2, a Fairchild 71 and a Travelair 6000. Then, for fun, they had a Taperwing Waco. My flying for them included passenger hopping, testing, demonstrating and some cross-country trips (some more interesting than others).

Early in the morning of April 27, 1929, Bob Hewitt, who was still on crutches, phoned me and said that the Chamber of Commerce was *willing to pay* to have a plane fly down to Wilmington that morning to pick up Amelia Earhart and bring her back to Philadelphia for a reception and dinner in her honor. So I dashed out to the airport and found that they already had the new 6 passenger Fairchild 71 on the line and warmed up. Since it was my first flight in that type of plane, I took it around the field and landed it a couple of times before heading for DuPont's private field near Wilmington. I got Amelia to Philadelphia in plenty of time for her luncheon engagement. Next day (also on the Chamber of Commerce) I took her on an aerial tour of the "City of Brotherly Love."

Later in April, Brooks Parker, an insurance executive, wanted to fly a party down to the races at Havre de Grace, Md. One hitch was that he wanted to be set down on the track infield. It was early and there were very few people on the infield, the approach was good, only a low fence to get over, so we set down with plenty of room. Getting the field cleared off after the races for our trip home was a bit more of a problem.

On July 3, 1929, the Ludingtons started a summer weekend line from Central Airport to Cape Cod, departing Central Friday afternoon and arriving back Monday morning. The Fairchild 71 and Travelair 6000 were assigned to the run and four

Dinner in honor of
Amelia Earhart Putnam
in recognition of her
Solo Trans-Atlantic Flight
given by the
Aeronautical Chamber of Commerce
of America
June twentieth, Nineteen thirty-two
The Waldorf-Astoria

Speakers

CHARLES L. LAWRANCE
PRESIDENT, AERONAUTICAL CHAMBER OF COMMERCE OF AMERICA, INC.

DON L. BROWN
PRESIDENT, PRATT & WHITNEY AIRCRAFT COMPANY

HON. W. IRVING GLOVER
SECOND ASSISTANT POSTMASTER GENERAL

AMELIA EARHART PUTNAM
GUEST OF HONOR

Menu

SUPREME OF MELON TRI-COLOR

STRAINED CHICKEN GUMBO CREOLE
PAILLETTES AU PARMESAN

HEARTS OF CELERY RIPE AND GREEN OLIVES
SALTED ALMONDS

FILET OF ENGLISH SOLE BONNE FEMME
PARSLIED BERMUDA POTATOES

MOUSSELINE OF SWEETBREADS REGENCE
WITH FRESH MUSHROOM SAUCE

SAUTE OF BABY CHICKEN PORTUGAISE
WITH TRUFFLES DU PERIGORD
TOMATOES PROVENCALE
NEW GREEN PEAS

COLD ASPARAGUS TIPS d'ARGENTEUIL
CALIFORNIA DRESSING

FROZEN MOUSSE MIRABELLA
WITH FRESH BRANDIED PEACHES
ASSORTED FANCY CAKES

DEMI-TASSE

Sanger Green and Amelia Earhart, Philadelphia Airport, April 4, 1929.

pilots (including myself) were provided with neat conservative uniforms. I had the honor of flying the first passengers in the Fairchild. Two of the passengers wanted to deplane at Jamestown (an island in Narragansett Bay across from Newport). The others were going to our terminal in a field on the Coonamessett Ranch near Falmouth. I never had even seen either place and my Jamestown passengers had no idea of where we could land, so after looking around a bit I set the ship down in a cemetery that had enough unobstructed room. We were not entirely welcome. Some of the people in the crowd that gathered were saying things about desecration and police, so I unloaded the passengers quickly and took off before Smokey could get there.

Although the line was supposed to be from Central to Cape Cod, there were usually variations. One time I had to find a place to land on Fisher's Island and several times I had to land at Martha's Vineyard or Nantucket (the latter two are islands just south of Cape Cod). There are a lot of deserted beaches on the south side of Martha's Vineyard, so when I had to go to Nantucket I would fly along them at treetop height and give my passengers a view of the "buff" bathers rushing to cover up. On one trip late in August I had to go to Nantucket with a stop at Newport. Headwinds had made me a trifle late, so by the time I left Nantucket alone for Falmouth it was getting real dusky. There were no lights on the field at Coonamessett, but Bob Hewitt, who had gone ahead of me in the Travelair, had a half dozen autos lined up at the approach to the field with their headlights shining down the field. Since I didn't have enough gas to take me to Boston, I had a "Hobson's choice" and came in over the parked cars as low and slow as I could. The lights didn't illuminate very much of the field so on touchdown I cut my ignition switch and stood on the brakes. I ended up about three feet from a big haystack.

The Coonamessett people really "did themselves proud" (as they say in New England). We had a small cottage, fully equipped, to ourselves. Our arrival night dinner always consisted of all the steamed clams and lobsters we could eat, with all the trimmings and a homemade desert. All our meals over the weekend were on the same scale. Regrettably this Cape Cod caper only lasted one season (1929). I guess the passengers were buying their transportation cheaper than the Ludingtons were.

Next month some happenings at Central Airport, air races, etc. Hope you have as much fun reading the column as I have writing it.

Firsts

In the Log of Amelia Earhart Putnam

"THIRTEEN HOURS AND THIRTY MINUTES"

1920	Learned to fly in California. Established Women's altitude record of 14,000 feet. (Kinner Airster)
June 17–18, 1928	*First* woman to span the Atlantic in an airplane, flew as a passenger with Wilmer Stultz, pilot, and Louis Gordon, mechanic, from Trepassey Bay, Newfoundland, to Burry Port, Wales, 2,140 miles in 20 hours and 40 minutes. (Whirlwind-powered Fokker "Friendship").
September-October, 1928	*First* woman to make round-trip solo transcontinental flight across United States. (Avro Avian)
March 28, 1929	Fourth woman to receive transport pilot license from Department of Commerce.
November 22, 1929	Established world speed record for women over a closed circuit course at Detroit with an average speed of 184.17 miles per hour. (Wasp-powered Lockheed Vega)
December 14, 1930	*First* woman to fly an autogiro in the United States.
April 8, 1931	Established an altitude record of 18,415 feet for autogiros at Willow Grove, Pa. (Whirlwind-powerd Pitcairn)
May 28–June 22, 1931	*First* to make a transcontinental flight across the United States in an autogiro. (Whirlwind-powered Pitcairn)
May 20-21, 1932	*First* woman to fly an airplane solo across the Atlantic. *First* person to span the Atlantic twice by airplane in non-stop flight. Her time, 13 hours and 30 minutes for the 2,026 miles from Harbor Grace, Newfoundland, to Londonderry, Ireland, was the fastest for the Atlantic crossing and established a world's distance record for women. (Wasp-powered Lockheed Vega)

CONTESTS

Editor:
Robert Baker WA1SCX
34 White Pine Drive
Littleton MA 01460

ARRL STRAIGHT KEY NIGHT

Starts: 0100 GMT Saturday, July 3
Ends: 0700 GMT Sunday, July 4

Check *QST* for any changes in the rules!

Basically, rules require the use of a straight key only. Send "SKN" instead of "RST" during QSOs, to help identify contest stations. On 80-40-20 meters, try 060 to 080 kHz up from the bottom edge of the band. On Novice bands, try 10 kHz up from the bottom of the Novice band. After the contest period, send a list of calls of the stations contacted during the contest period, plus your vote for the best fist heard. Please mail entries as soon as possible to ARRL, 225 Main Street, Newington CT 06111.

QRP SUMMER CONTEST

Organized by the Activity Group-CW in Germany
Starts: 1500 GMT Saturday, July 3
Ends: 1500 GMT Sunday, July 4

A maximum of 15 hours' operation is allowed during the contest period, with the 9 hour pause taken in a maximum of 2 parts. General call is "CQ QRP." Maximum power for QRP stations is 9 Watts input.

EXCHANGE:

RST and QSO number/input. Add "x" if transmitter is CO or VXO controlled.

SCORING:

All QSOs are valid. Own country – 1 pt.; own continent = 2 pts., and DX = 3 pts. per QSO. Add an additional 3 points per QSO for a QSO with another QRP station. Handicap points (hcp) are given if either station is using below 3.5 Watts input or is xtal controlled, with a maximum of 4 hcps possible. Both stations multiply QSO points by 1 plus the hcps. Example: W2XX works G9XX, exchange 589 001/2x from W2XX, 579 100/4x from G9XX; both stations score 9 pts, for the QSO (3 pts. for DX x 3 hcps – both xtal, W2XX less than 3.5 Watts). Multipliers are 1 for each country in own continent and 2 for each DX country per band according to latest DXCC list (but call areas in JA, PY, VE, VK, W, and ZS count as separate countries). Final score is total QSO points times total multiplier.

QRO STATIONS:

Same rules, but input power is not limited. Use QRO and only QSO with QRP stations. Scoring is the same.

ENTRIES:

Send a "mini-log" by July 31st to: Hartmut Weber DJ7ST, D-3201 Holle, Kleine Ohe 5, Fed. Rep. of Germany.

CW COUNTY HUNTERS CONTEST

Starts: 0000 GMT Saturday, July 17
Ends: 0600 GMT Monday, July 19

The CW County Hunters Net (7055 and 14070 kHz) invites all amateurs to participate in the 1976 contest. All mobile and portable operation in less active counties is welcome and encouraged. General call is "CQ CH." Portable or mobile stations changing counties during the contest may repeat contacts for QSO points. Stations on county lines give and receive only one number per QSO, but each county is valid for a multiplier. Each station may be worked once per band.

EXCHANGE:

QSO number; category (portable = P, mobile = M); RST; state, province, or country; and county (for US stations only).

SUGGESTED FREQUENCIES:

3575, 7055, 14070, 21070, 28070 kHz.

SCORING:

QSOs with fixed stations count 1 point per QSO; portable or mobile stations score 3 points per QSO. Multiply the number of QSO points times the number of US counties worked. Mobiles and portables should calculate their score on the basis of total contacts from within each state.

AWARDS:

Certificates will be awarded in three categories.

F – Highest fixed or fixed portable station in each state, province, and country with 1,000 or more points.

P – Highest station in each state with 1,000 or more points operating portable from a county which is not his normal point of operation.

M – Highest mobile in each state operating from 3 or more counties with a minimum of 15 QSOs per county.

Trophies will be awarded to the highest single operator station in the US in categories P and M. The awards committee will issue additional awards where deemed appropriate.

LOGS:

Logs must show category, date/time in GMT, station worked, exchanges, band, QSO points, location and claimed score. All entries with 100 or more QSOs *must include a check sheet* of counties worked or be disqualified from receiving awards. Enclose a large SASE for results. Logs must be postmarked by September 1, 1976, and be sent to: CW County Hunters Net, c/o Jeffrey P. Bechner W9MSE, 673 Bruce Street, Fond du Lac WI 54935.

QRP AMATEUR RADIO CLUB INTERNATIONAL, INC. 1976 ANNUAL AUGUST QRP CONTEST

Starts: 2000 GMT Saturday, August 21
Ends: 0200 GMT Monday, August 23

This contest is open to all amateurs, and all are eligible for awards.

EXCHANGES:

MEMBERS = RST/RS; State/province/country; QRP nr. NON-MEMBERS: RST/RS; State/province/country; Power.

SCORING:

Stations can be worked once per band for QSO and Multiplier credits. Each MEMBER QSO counts 3 points, NON-MEMBER QSO 2 points. Stations other than W/VE count as 4 points. Score = QSO points times total number states/provinces/countries PER BAND times power multiplier.

MULTIPLIERS:

More than 100 Watts input power . . . X1; 25-100 Watts input power . . . X1.5; 5-25 Watts input power . . . X2.0; 1-5 Watts input power . . . X3.0; Less than 1 Watt power . . . X5.0.

FREQUENCIES:

CW = 3540, 7040, 14065, 21040, 28040. SSB = 3855, 7260, 14260, 21300, 28600. Novice = 3720, 7120, 21120, 28040. All freqs. are plus or minus 5 kHz or so, to dodge QRM.

CALL:

CQ QRP DE (callsign).

AWARDS:

Certificates to the highest scoring station in each state, province or country. Other places will be given depending on activity. One certificate for the station showing three "skip" contacts using the lowest power.

LOGS:

Send logs to: E. V. Sandy Blaize W5TVW, 417 Ridgewood Drive, Metairie LA 70001. Send full log data, including your FULL name and address, bands used, equipment, antennas and power used. Entrants desiring result sheets should enclose a #10 SASE. Logs must be received by September 30, 1976 to qualify.

EURD AWARD

This award is offered by the DARC in three classes for two-way RTTY contacts with different European countries and prefixes. All amateur bands, including VHF, may be used. All contacts must be confirmed and dated after Jan 1st, 1965. Contacts during the RTTY WAE DX Contest can be used for EURD endorsements, provided the log of the requested station is also received. Requests must

Continued on page 158

CALENDAR

Jun 26 - 27*	ARRL Field Day
Jul 3	Straight Key Night
Jul 3 - 4	QRP Summer Contest
Jul 17 - 19	CW County Hunters Contest
Jul 24 - 25	ARRL Bicentennial Celebration
Aug 7 - 8	10-10 Net Summer QSO Party
Aug 14 - 15	European DX Contest – CW
Aug 21 - 22	SARTG Worldwide RTTY Contest
Aug 21 - 23	New Jersey QSO Party
Sept 4 - 5	ARRL VHF QSO Party
Sept 11 - 12	European DX Contest – Phone
Sept 18 - 19	Scandinavian Activity Contest – CW
Sept 25 - 26	Scandinavian Activity Contest – Phone
Sept 25 - 27	Delta QSO Party
Oct 8 - 10	CD Party – Phone
Oct 9 - 10	RSGB 21-28 MHz Contest – Phone
Oct 16 - 17	RSGB 7 MHz Contest – CW
Oct 16 - 18	CD Party – CW
Oct 30 - 31	CQ Worldwide DX Contest – Phone
Nov 5 - 8	IARS-CHC-FHC-HTH QSO Party
Nov 6 - 7	RSGB 7 MHz Contest – SSB
Nov 6 - 8	ARRL Sweepstakes – CW
Nov 13 - 14	European DX Contest – RTTY
Nov 14	OK DX Contest
Nov 20 - 22	ARRL Sweepstakes – Phone
Nov 27 - 28	CQ Worldwide DX Contest – CW
Dec 4 - 5	ARRL 160 Meter Contest
Dec 11 - 12	ARRL 10 Meter Contest
Dec 31	Straight Key Night

* = described in last issue

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LETTERS

THE PROVERBIAL LADDER

73 and its staff have helped me more than *QST* and the staff that publishes that magazine. Matter of fact, I'm thinking seriously of not renewing my subscription to *QST* when it expires this coming August. The ARRL hasn't been that much of an aid in my climb up the proverbial ladder of hamdom.

Your records, which I'm certain you keep for at least a year, will show that I'm not only a subscriber, but nave ordered, thusfar, your 14 wpm tape. Which, by the by, is "working" after about 2 hours of practice. Of course, I've had X number of hours on the air as a Novice, and other means of practicing CW for that damn FCC General Exam.

I am going for the General Exam and would like not to blow my hard-earned $4.00 and time sans at least studying your *General License Study Guide*, for which I've enclosed my personal check for $5.95. When (positive thinking, as opposed to "if") I get my General, I'll be happy to let you know.

Always good luck to you and your crew, and keep on saying what you please when you please.

Joe Marymount WN2TXQ
Teaneck NJ

THE WRONG PEW

Thanks for your excellent service in regard to my subscription. I really didn't think I would receive all the copies I requested, and so quickly. You rank far above any magazines I have subscribed to. Matter of fact, I shouldn't even compare you with other magazines. Being a man of good faith, I should have believed and expected great things from you. Well, perhaps I was weak — but am now made strong by people interested in other people. Enclosed is a Reader Service request I know I will receive the same prompt service.

You see, it's all-important for someone like me, who is just starting out in this ham business, to get all the encouragement possible. I don't know which rig to begin to shop for. With your help, I'm sure I'll be able to make a wise and educated choice.

Keep the articles coming which push us beginners along, because we often get discouraged when there is no help around. We especially get a droopy mustache when we get bogged down in code. It's so hard to turn the corner from 12 wpm to 13 wpm.

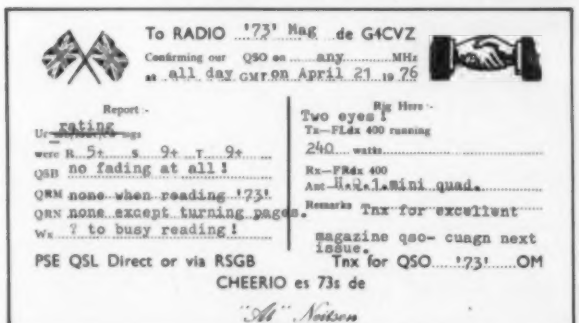
Would you by chance know if anyone in my area willing to help me with that final step in code? Just about there, but not quite. Also, Wayne, I have a nice CB rig I'd like to sell someone. It'll help finance my ham rig. I have two brothers who are hams — both were into CB. Ah, the joys that are theirs now. I don't want to be left behind. So please help.

My brothers, Leo and Gene, are in other states, so all they can do is to keep the cards and letters pushing me.

As I go through the letters to the editor, I notice all the compliments — so what more can I add, but that I'm dealing with people and not just another money machine. Thank you!

Brother Andrew Patin, C.S.S.R.
Saint Alphonsus Church
224 Carrier Street, N.E.
Grand Rapids MI 49505

Brother Andrew, you are sitting in the wrong pew as far as code is concerned . . . stuck at 12 wpm indeed! This tells me plainly that you are trying to avoid the Wayne Green Code Cassette system of learning the code, a system which does not try to get you to learn the code at ten different speeds . . . just at two . . . six wpm and 14 wpm. Obviously, you are trying to penny pinch and not invest in the 14 wpm code cassette which 73 *happily foists off on unsuspecting readers . . . and this is the root of your trouble, and a well rounded round of tsks for any brothers of yours who steered you into the 12 wpm cul de sac. Thanks for the nice letter otherwise and harken to the above. — Wayne.*


To RADIO '73' Mag de G4CVZ
Confirming our QSO on any MHz
as all day GMT on April 21 19 76
Report - rating
Ur [illegible] sigs
were R 5+ S 9+ T 9+
QSB no fading at all !
QRM none when reading '73'.
QRN none except turning pages.
Wx ? to busy reading !
Rig Here -
Two eyes !
Tx—FLdx 400 running
240 watts
Rx—FRdx 400
Ant—Hi-l.mini quad.
Remarks Tnx for excellent magazine qso- cuagn next issue.
PSE QSL Direct or via RSGB
Tnx for QSO '73' OM
CHEERIO es 73s de
"Al" Neilson

Having just received my April issue of *73*, I thought I had to put pen to paper to compliment the gang on producing what surely must be rated as the best ham magazine in the world! I subscribe to quite a few American and British mags, and for sheer quality, quantity, practicability and up-to-date state of the art articles, *73* not only beats the rest — it murders them! I am sure my postman has the lifelong task of delivering my *73* mag!

The only disadvantage is that *73* spoils me for choice, as any IC article causes me to have constructor's itch.

Keep up the great job and don't change anything (except perhaps the price, which is understandable!).

Al Neilson G4CVZ
Liverpool, England

HEAD AND SHOULDERS

We really enjoyed "The Smart Power Supply," by WA4SAM in the March issue of *73*.

The same IC has been used here for about four years now with great success. We use it for controlling an electroformation process. We are using 144 plug-in cards almost identical to John's card. The cards control 345 transistors mounted on water-cooled heat sinks. For dc power we use two rectifiers rated at 500 Amps, at 75 volts each.

John's article was well written and to the point. His kind of article caused us to subscribe to *73* in the first place!

Keep up the good work, and keep the computer articles coming each month! *73* is head and shoulders above the other ham rags!

Wm. Dunnivant
Commercial Electronics
Baxter Springs KS

ROTTEN LITTLE KID

Last week I mailed you a letter inquiring as to the whereabouts of tapes I ordered. Today, I finally received the tapes! Your package was postmarked February 11, 1976. It took our glorious, gov't operated Post Office 12 days to move the tapes from N.H. to Ala. Heaven help us if the liberal politicians have their way and take over the oil companies. Can you imagine the oil delivery? The tapes are excellent!

Lucius B. Ramsey
Spanish Fort AL

A short note to praise the 13+ wpm tape. I sent for one and used it a total of 6 hours and 35 min. I took the General test at Syracuse April 14 and the test (code) sounded like 10 wpm — and I passed. Had taken the test last Jan., but blew the code so I took the theory and got a Tech. So I tried your tape and it really gets the job done. Now I am going for my Advanced. After all, my 19 year old son passed his Advanced last Nov., the rotten little kid.

Waldo Longwell, Jr. WA2EMJ
Horseheads NY

ADDS, TOO!

I am an owner of the Texas Instruments SR-50 calculator. One day I was listening on 2 meter FM and working out a math problem at the same time. I noticed that the oscillator in the SR-50 was generating a respectable signal on 146.82.

In fact, the LED display generates random noise pretty much evenly distributed through the rf spectrum. It really makes a good noise source to peak up a VHF receiver. By wrapping 2 or 3 turns of wire around the display and connecting the wire to the antenna jack, you create an instant noise source. This probably holds true for any calculator with an LED display.

If you have an SR-50, press 99. Then press the factorial key. You will hear a pulsed 1 kHz tone in your receiver. This is an error display, so any answer that the SR-50 sees as invalid will cause the display to blink.

This blinking occurs about twice per second, depending on battery conditions. This beeping is especially nice when the natural noise level is especially high. Oh, yeah, the SR-50 can add, too!

Paul J. Dujmich WA3TLD
McKeesport PA

PLEASING MARY

Just a short note to tell you I enjoy your publication a great deal. Sometimes they're a little late getting to me here in the Philippines, but then I'm not always in town when they arrive. Anyway, I hope you will forgive me

for sending in my Reader Service forms a little late; I didn't mean to upset Mary — I didn't even know . . . anyway if it helps I will make a few extra forms myself to send in next month (pestilence in triplicate). If all your readers do likewise, I'm sure Mary will be very pleased!

J. B. Fields
Subic Bay, R.P.

"MIRANDA" OF MAGAZINES

Thanks for the "announcement" on the Table of Contents page in the April 1976 edition of *73*. It looked like a "throw-in" as a "rub it-in-yar-nose" adjudicative settlement. Sometimes the Telephone Company can be didactic to the point of absurdity. The "announcement" smacked of the literary style used by the Surgeon General. No doubt the California Court started an irreversible trend . . . and your mag had it first once again . . . Think of it, a Section 315 for publishing; a "Miranda" of magazines . . . wow . . . articles on two meter transmitters now have to be preceded with: "Note to readers: Construction of this project is illegal if you steal the parts to build it." The April antenna issue should have announced boldly: "Construction of any antenna in this super edition of *73* could lead to your violating peeping tom laws" . . . or how about articles on weather satellites . . . "Note: Information obtained from weather satellites may not be sold to foreign governments for purposes of aggression."

The California Court quite obviously has little appreciation for the integrity of your clientele. Further, they understand little about our need to know. Your reaction was probably like mine and thousands of others: "So what? Most knew how it was done anyway." What difference does it make? Telcos find it hard to give you information which is "cleared" for dissemination, so now maybe some of our "legitimate" questions will be answered. Quite frankly, the article gave me a new respect for the importance of "in-band energy suppression" on my approved QKT coupler. Thanks to that big bold announcement, I was able to relocate and reread the article to see if I had missed anything the first time around.

John S. Hollar W3JJU
Harrisburg PA

TOO LONG TO WAIT

I want to say what I have been going to for some time. In my opinion your magazine, large or small format, is undoubtedly the most up to date with state-of-the-art on the market today. The only problem is, unlike other ham magazines, one month is too long to wait between issues. Keep up the good work.

K. L. Freeland W1ANF
Nashua NH

PROUD W

Because I read another ham's *73* and admire it and its publications, here's a communication pertinent to the times and the year:

Our W and K prefixes have been so well known throughout the world for such a long time that everyone knows the American hams thereby. There is no reason to masquerade as something else with that alias, "AC" I I'm proud to have held W1, W8 and W9 calls over 44 years and shall continue with the proud "W".

Temple Nieter W9YLD
Evanston IL

ACE

Everybody, it would appear, has a name. Amateur operators are called hams (ugh!), operators in the Citizens Radio Service are CBers, and so forth. But what of the person who likes to experiment with computers???!

In answer to the question above, I would like to propose that a person who "plays" with computers be called an "ACE": *A*mateur *C*omputer *E*nthusiast. What do you think?

Theodore J. Cohen W4UMF
Alexandria VA

The term "Computer Hobbyists" may stick . . . if any newsletters in the field discover how to spell it (several spell it hobbiests). Most hobbies have not developed terms such as "ham" . . . not that we know for sure where that term really got started. Camera hobbyists are called camera nuts, camera fiends, etc. Amateur astronomers are called just that. ACE is ace with me, but I'll bet you can't make it stick. — Wayne.

TAPEWARN

While the "three-for-a-buck" cassette tapes are clearly unsuitable for data storage use, our experience is that "the best you can get your paws on," as suggested in your interesting "Nifty Cassette" article (May, 1976), is a potentially considerable expense that is usually not required. While price is a general indicator of oxide integrity and of construction quality, it is an inefficient and costly guide, since the extended high frequency performance is not at all necessary for data uses.

Extensive testing by a consortium of local schools and colleges resulted in the recommendation of three brands for a similar data storage use: Maxell, Scotch Highlander, and Omega. Highlander tapes are widely distributed at modest cost, while the Omega is a private brand, manufactured by 3M, and distributed in the midwest. The latter has proven particularly suitable in our own system, as it is lowest in cost, yet utilizes a fine mechanical system of stainless steel chutes rather than rollers; moreover, it is available in 30 minute length, required by some drives and no longer widely available in quality tape lines. We recommend the 30 or 45 minute lengths over 60 minute size, as the tape is thickest in these sizes. Using 30 minute Omega tapes for semicommercial use, we have had no problems attributable to tapes in several months.

I caution against purchase of "digital tapes" at premium price; at least one custom "digital cassette" label is simply a rebranded, untested, standard line TDK audio cassette. On the rare times that real-and-true *data certified* tape cassettes are required, we have found that Artec International has attractive prices — especially in modest quantities — at their nationwide branches. If readers should desire Omega cassettes in locations where these are not available, our school bookstore will supply purchasing assistance upon receipt of an SASE. Send SASE to: Resource Access Center, 3010 4th Avenue South, Minneapolis MN 55408.

Richard B. Koplow
Minneapolis MN

NO DREDGING

I spoke to you one day last year when you called Gary W3DTN looking for FCC info to publish. My question to you at the time was, how good are those new code tapes? Are they really different? You said they were much better than Brand X and Y. You know — you were right. They are good. Thanks.

Now I have a question for this year. As background, I have a 240Z and I understand you push around a Z yourself, so maybe you will be sympathetic to my problem. I want to run 6 and 2, plus broadcast, off one antenna (hopefully replace the B/C antenna with a Larsen). Thus far, I have found no understandable info on splitters, filters, matching units, etc., that would help. As I don't want to clutter up an otherwise clean car with multiple antennas — I need help. Any chance you could dredge up something to publish on the subject?

Marvin T. Storey WA3RKA
3212 Cordoba St.
Silver Spring MD 20904

No. — Wayne.

COMPUTER CALL

Persons in the Huntsville/North Alabama area interested in any aspect of amateur or hobby computing are invited to join the North Alabama Computer Club (NACC). Please contact me.

Dr. Jack W. Crenshaw
1409 Blevins Gap Rd. S.E.
Huntsville AL 35802
(205)-859-7344 or
(205)-883-7973

OH, HENRY!

I would like to take this opportunity to express my pleasure with the superior service provided by Henry Radio. I have had several dealings with the Butler, Missouri store by mail during the last year and have always found their service to be very prompt and highly satisfactory.

Ken Morgan WA5VUZ
Albuquerque NM

ALDELCO DELIVERS

You may have received a few letters of complaint concerning the failure of Aldelco to deliver 2N5590 rf transistors. We had an unfortunate situation in that we inadvertently advertised the price of this unit at $4.15, which is below our cost. We sent out our entire stock of 2N5590s and immediately ordered more. Delivery from the factory has been held up and we hope to be able to fill every order at the $4.15 price in the next few days, even though we lose money on every order sent out. Being new in the mail order business, we are trying to build a reputation for good service and quality merchandise. Every order received is sent out within 48 hours if we have the item in stock. However, like any other company, we have our problems like outbreaks of the flu, vacations, etc. We will, however, continue to do our best to serve our customers.

Alfred G. Smith
Aldelco
Lynbrook NY

IN LOVE

Okay, I cannot put it off any longer: I must write and tell you how much I enjoy *73 Magazine*. The May 1976 issue came recently and, as usual, I quickly leafed through it and noted all the good articles I would peruse at my leisure. Later I shall fold down the corners of those pages on which I find something of special interest. Even later I may index everything.

I admit it — I love *73*. Before you people get puffed up with pride, though, there are other magazines I also enjoy. In fact, the mailperson must wonder if I do anything but read magazines. Magazines such as *The Audio Amateur* (I'm glad to see they've wised up and moved to N.H., even if it is just down the street from *73*. Some day I must come to Peterborough: then I can not only visit *73*, *TAA*, and Old Colony Sound; I can also drool over the tools at Brookstone. Ah, heaven . . .), most of the *Popular Whatevers, Analog, Scientific American, Track & Field News*, etc. However, so far only *73* (and, yes, Wayne) has inspired me to think about writing articles. I have even gone so far as to jot down ideas. And

I'm not even a ham yet, although I'm working on it, helped considerably by your study guides and code tapes.

Keep up the good work.

Gordon J. DeWitte
Somersworth NH

P.S. Count me among those pleased and impressed with James Electronics and S. D. Sales. Both have been great.

NOBODY ELSE WILL

Today I heard a story on WBBM (780 AM in Chicago) which reported that an amateur radio station was misguiding aircraft on landing at Rome's airport.

I called the station and complained. They gave me the number of Reuters, the source of the story. The complete story filed in Rome stated that authorities believed the problem was due to a terrorist group. I called WBBM back and explained that they should not give incomplete stories when the meaning thereby is completely changed.

Both the station and Reuters commented that I was nitpicking. Not at all. There are now at least 3 people in the news business who now know the distinction between a terrorist with a pirate radio and an amateur radio operator.

We have to start somewhere. If amateurs don't defend themselves, nobody else will.

Keep stirring things up.

John Lorenz WA9RDV/9
Kankakee IL

AUSTRIAN WELCOME

The Austrian Radio Amateur Society (ÖVSV) celebrates its fiftieth anniversary this year. From June 17th until June 20th, 1976, there will be a large festivity at Krems an der Donau (near the Wachau, Lower Austria), in memory of the foundation of the ÖVSV. We will be most pleased to welcome as many XYLs, YLs and OM from abroad as possible.

Here is a general summary:

Thursday, 17th of June: Approach competition on 144 Mc to 146 Mc from 1 pm to 6 pm.

Friday, 18th of June: Foxhunting competitions. Participants from abroad are most welcome. 80m foxhunting in the morning, 2m foxhunting in the afternoon. In the evening there will be a jolly evening with "Heurigen" (new wine) at Langenlois.

Saturday, 19th of June: Sightseeing at Krems. Opportunity to make a boat trip on the Danube to the famous Wachau. In the afternoon: coach trip to the Wachau and the abbey of Melk. In the evening, a big ball and distribution of awards at the Stadtsaal Krems. The military band of the Niederösterreich command will play.

Sunday, 20th of June: Memorial ceremony, speeches and symphony concert. Afterwards, a cold buffet. Afternoon and evening: farewell party at Stift Göttweig (abbey of Göttweig).

Organization center: Parkhotel Krems. Room reservations (priced between 100 and 350 Austrian schillings): Fremdenverkehrsamt Krems, Kunstlerhaus, WichnerstraBe, A-3500 Krems, Austria.

To commemorate the fiftieth anniversary of the ÖVSV, all OE stations have been authorized to use the prefix OE50 from the 1st of April until the 1st of July. During the same time, a special station will operate with the callsign OE50/3XKW.

To help with the approach, there will be some repeaters active on the 2m band, especially OE3XHW (Hohe Wand) on R5, OE3XPA (St. Pölten) on R8, OE1XWW (Wien) on R6 and a special repeater, OE3XSA (Krems), on R4.

Participants from abroad will have plenty of opportunity to meet many Austrian OM personally. We look forward to an eyeball QSO at Krems an der Donau!

Dr. Emmerich Rath OE3RE
Langenlois, Austria

EXTRA DOUGH

How many of you go out and spend $50 or more for a 12 volt power supply to run your solid state two meter rigs? I purchased a Regency HR-2B without the ac power supply. Next I went around to the local gas stations until I found a good used 12 volt battery (which I only paid $1.00 for). Then I ordered a small trickle charger from Olson Radio for $1.49. I have been running the rig ever since.

Also, this makes for a nice emergency setup in case the ac power goes off. With the extra dough left over, take the XYL out for supper.

Richard A. Little K9EEH
Sterling IL

LEAN ON OTHERS

William Cook's letter in the May *73* has moved me to respond. My sympathy goes out to you, Bill. Constructing a transmitter, receiver, T-R circuit, or whatever, from scratch can be an overwhelming project for the beginner.

I've built receivers, transmitters and test items from magazine articles, and frequently departed from the author's suggested parts layout because some critical item or other had to be substituted. Bill, things are never perfect. Even prospective hams have to make trade-offs and compromises. So you might as well start now.

This letter is written by a guy who used to invade the junk heaps in search of cast off radio parts. Once I even brought home a rubbish-contracted skin disease. Many of the scrounged parts ended up in transmitters used on the air. You see, money to buy parts was kind of scarce in those years.

My recommendation to you is to look for kindred souls in your area through Ham Helps or by listening on 75 or 2 meters and tracking hams down from their addresses in the Radio Amateur's Callbook Magazine. (Sneak a look in the Callbook while visiting a radio parts store some time, if it's too expensive to buy one.)

Then get acquainted. Lean on others for awhile, until you learn to walk alone in this tremendous hobby. Maybe some day you can become a leader. Good luck.

Paul L. Schmidt W9IDP
Bloomfield IN

P.S. Your town of Alpena, Mich., has some 30,000 people. There should be a ham or two in town who can help you get started.

SWAPPER

I'll be glad to swap my time in helping you set up, program, debug, etc., a microprocessor, in exchange for using or acquiring a system, the hardware. I have background in systems/programming: many systems, many languages, assembly and higher level languages. Please contact me to discuss situation.

Toby Maki
102 Minott Rd.
Westminster MA 01473
(617)-874-5410

YASME: THE BLOW STRUCK!

This is a report on the YASME operation during the month of March in the Republic of Nauru under the call C21NI. Approximately 7500 QSOs were made with amateurs in 116 countries. While, at other stops in Pacific arcas, Europe was workable from only a few minutes to a very few hours, from C21NI there were some beautiful openings to Europe. One day the band was continuously open to Europe for 10 hours.

The first QSO from C21NI was with JA5DH on 1 March 1976. The last QSO was with UB5JBY on 25 March 1976. Some 1500 QSOs were made during the last half of the ARRL SSB DX competition and again some 1500 QSOs were made during the last half of the ARRL CW DX Competition.

We made arrangements by radio for our next stop to be YJ8 (New Hebrides). We had written permission to operate there. We had an apartment rented there (from YJ8DE). We had our plane tickets, etc. It was impossible in Nauru to obtain a visa to anyplace, but we had been told in the Fiji Islands (by the French Chargé d'Affairs) that no visa was required for a 30 day visit. We arrived safely in Vila, New Hebrides; all of our gear was taken off the plane; people were waiting to greet us. Transportation was waiting to take us to our apartment. Then the blow struck! The Head of Immigration (British) said that we could not enter the country without a visa and that he would not issue one in Vila. We were ordered to get back on the plane that we had just left and leave the country immediately. We protested and almost refused to go – however, there were lots of policemen there and it appeared that we would be either forcedly put on the plane or forcedly taken to jail. After holding up the plane for nearly an hour, we found ourselves and all of our gear back on the plane bound for New Caledonia.

Lloyd Colvin W6KG
Iris Colvin W6DOD
Noumea, New Caledonia

THE MIDAS TOUCH

It is unfortunate that there are those who feel that criticism should be expurgated from *73*. There are many countries today where criticism is discouraged and the press contains references to omniscient leaders whose infallible decisions have meant the Midas Touch to the fortunate publications who are privileged to pay taxes and make other support (and who might disappear if they were to voice any critical comments). I suppose if I were high on the totem pole, I would not like criticism either; but criticism is good for the public – it keeps officials on their toes, keeps people honest, and in the long run is beneficial to all society. Whereas I may not agree with editorial content, I support a person's right to that opinion and his right to publish it. That's the American plan! (And we can buy tubes from Amperex and RCA!)

Paul Schuett WA6CPP/WA7PEI
Wallace CA

R/Os NEEDED

For benefit of any readers who are unemployed, please place this small note somewhere in *73*: " Radio Officers needed urgently. Six months endorsement program with pay very likely."

D. Boone
POB 330
Valley Mills TX 76689

RACE RESULTS

This past February I wrote to you complaining of the lateness of my first issue of *73* (I had not received my January issue yet) and challenged you to beat the ARRL response to a similar complaint some years back that I made. Namely, my challenge

Continued on page 51

FIELD DAY WEEKEND

Since extra Field Day points can be gained by making contacts via the OSCAR satellites, it has been decided to change the operating schedule of OSCAR 6 for FD weekend. In order to keep the satellite's battery more fully charged, the first three orbits of the 26th of June which would normally be on will be kept off. The following AMSAT-OSCAR 6 orbits will be turned *on* for FD QSOs (starting Sat., June 26, 1976):

Orbit	Eq. Crossing Time (GMT)	Longitude °W	Call Areas in Range
16906	18:07	327.6	Northern W1, 2, 3, 8, 9, Ø, 7 states & VE, KL7, KH
16907	20:02	356.4	Same as previous orbit
16908	21:57	25.1	W1, 2, 3, 8, 9, Ø, VE, KL7, northern W4 & W7
16909	23:52	53.9	All states except KH6, all VE
16910	01:47	82.6	Same as previous orbit (June 27)
16911	03:42	111.4	W5, 6, 7, 8, 9, Ø, VE3-8, KL7
16915	11:22	226.4	W1, 2, 3, 4, 8, 9, VE1-4
16916	13:17	255.1	All states except W6 & KH. VE1-6 & eastern VE7
16917	15:12	283.9	All states except KH6
16918	17:07	312.6	All states except southern W4
16919	19:02	341.4	Northern W1, 2, 3, 8, 9, Ø, 7 & VE, KL7, KH6
16920	20:57	10.1	W1, 2, 3, 8, KL7, VE & northern W9, Ø, 7

The uplink passband of OSCAR 6 is 145.90 to 146.00 MHz; downlink is 29.45 to 29.55 MHz. AMSAT-OSCAR 7 will be in Mode B (70cm/2m) on GMT Saturday June 26. The uplink passband for Mode B is 432.125 MHz to 432.175 MHz. Downlink is 145.975 to 145.925 MHz. OSCAR 7 will switch to Mode A (2m/10m) at 00:00 GMT on Sunday, June 27, 1976. The Mode A uplink is from 145.85 to 145.95 MHz and the downlink is from 29.4 to 29.5 MHz. AMSAT-OSCAR 7 will be about 27 minutes behind its older brother OSCAR 6 during the Field Day weekend. The MAXIMUM effective radiated power for either satellite is 100 Watts. ERP equals the antenna gain times the power delivered to the antenna.

QRP TEST

All users of the 70 cm to 2m Mode B transponder of the AMSAT-OSCAR 7 satellite are invited to participate in a special three day low power (QRP) test which will occur on June 16, 17 and 18, 1976. The test will begin at 0000Z, 16 June, when the satellite switches from Mode A to Mode B on orbit #7245. It will be kept in this mode by AMSAT telecommand stations located in Canada and Australia. The final orbit of this three day test will be #7282 on Friday, June 18.

All stations using the transponder are urged to run *10 Watts* effective radiated power or lower, and those who cannot reduce power to this level are asked not to transmit in the 432 MHz uplink passband, since their presence will reduce the effectiveness of the many low power users who will participate in the QRP test. Signal reports sent should include the erp being used (i.e., RST 569 erp 5 W), so that those listening can get an idea of how effective low power can be via AMSAT-OSCAR 7 when the high power stations aren't hogging most of the available power.

Remember that one Watt into a 10 dB gain antenna system will produce the maximum recommended 10 Watts effective radiated power. If an exciter runs 10 Watts or more output, a half wave dipole will be a big enough antenna to use, and, if more attenuation is needed to reduce the erp, an old piece of lossy coaxial cable can be added to the existing transmission line. It doesn't really matter how the 10 Watts erp is achieved. The important thing is to run QRP for the three day test and send the results along with a station description to AMSAT, PO Box 27, Washington DC.

AMSAT

OSCAR 6 ORBITAL INFORMATION

Orbit	Date (July)	Time (GMT)	Longitude of Eq. Crossing °W
16960	1	0136:49	80.1
16972	2	0036:45	65.1
16985	3	0131:41	78.8
16997	4	0031:37	63.8
17010	5	0126:33	77.6
17022	6	0026:29	62.6
17035	7	0121:24	76.3
17047	8	0021:20	61.3
17060	9	0116:16	75.1
17072	10	0016:12	60.1
17085	11	0111:08	73.8
17097	12	0011:04	58.8
17110	13	0105:59	72.6
17122	14	0005:55	57.6
17135	15	0100:51	71.3
17147	16	0000:47	56.3
17160	17	0055:43	70.1
17173	18	0150:38	83.8
17185	19	0050:34	68.8
17198	20	0145:30	82.6
17210	21	0045:26	67.5
17223	22	0140:22	81.3
17235	23	0040:18	66.3
17248	24	0135:13	80.0
17260	25	0035:09	65.0
17273	26	0130:05	78.8
17285	27	0030:01	63.8
17298	28	0124:57	77.5
17310	29	0024:53	62.5
17323	30	0119:49	76.3
17335	31	0019:45	61.3

OSCAR 7 ORBITAL INFORMATION

Mode	Orbit	Date (July)	Time (GMT)	Longitude of Eq. Crossing °W
A	7433	1	0006:02	51.3
B	7446	2	0100:19	64.9
A	7459	3	0154:36	78.4
B	7471	4	0053:56	63.3
A	7484	5	0148:13	76.9
B	7496	6	0047:33	61.7
AX	7509	7	0141:50	75.3
B	7521	8	0041:10	60.1
A	7534	9	0135:27	73.7
B	7546	10	0034:48	58.5
A	7559	11	0129:05	72.1
B	7571	12	0028:25	56.9
A	7584	13	0122:42	70.5
BX	7596	14	0022:02	55.3
A	7609	15	0116:19	68.9
B	7621	16	0015:39	53.7
A	7634	17	0109:56	67.3
B	7646	18	0009:17	52.1
A	7659	19	0103:34	65.7
B	7671	20	0002:54	50.5
AX	7684	21	0057:11	64.1
B	7697	22	0151:28	77.7
A	7709	23	0050:48	62.5
B	7722	24	0145:05	76.1
A	7734	25	0044:25	60.9
B	7747	26	0138:42	74.5
A	7759	27	0038:03	59.3
BX	7772	28	0132:20	72.9
A	7784	29	0031:48	57.7
B	7797	30	0125:57	71.3
A	7809	31	0025:17	56.1

FOR YOUR EYES ONLY

Microprocessor/Micro-programing Handbook
by Brice Ward
293 pp., $6.95.

The economic advantages of the microprocessor, or "computer on a chip," have made them a popular and commonplace device in many commercial and industrial applications. The prolific use of microprocessors is bringing this technology to any forward-thinking person. As one becomes more familiar with the capabilities of microprocessors, his imagination devises applications.

Microprocessor/Microprograming Handbook provides a coherent introduction to the world of microprocessing. This readable text examines the vocabulary, architecture, memory systems, machine language, and assembler language of this exciting new technology. It provides valuable insight for the student or hobbyist interested in automation, electronics, or small computer applications, the engineer or technician who may be familiar with one microprocessor but would like to sample other architectures and their capabilities, and the business manager whose product could be improved by the incorporation of a microprocessor or who would like to be more familiar with the devices his staff is using.

Microprocessor/Microprograming Handbook is more of an introductory text on 4 and 8 bit microprocessors than a thorough handbook. Although there are more than 40 manufacturers of these devices, this text discusses the Motorola 6800 and draws heavily on the Intel 4040 and 8080 devices. Reference is made to 2 and 16 bit devices, but little information is provided.

As a text, it provides a sweeping view of the topic with enough detail to obtain a thorough understanding of several specific uPs. The devices detailed in this text are among the most popular used today. Its general ease of reading, along with helpful appendices for Abbreviations, Terminology, Manufacturers, and Support Chip Sets, provides valuable footing for amateurs and professionals interested in knowing more about these devices.

Electronic Conversions, Symbols & Formulas
by Rufus P. Turner,
Tab #750, 224 pp., $4.95.

This rather inclusive reference includes practically every formula that an electronic hobbyist would need for any use. Basic mathematical laws, functions, formulas and constants are presented, followed by fundamental and useful electronic design formulas.

Circuit design is usually accomplished in one of two ways — the amateur's way (cut and try) and the engineer's way (figure it out first). With this compendium of the needed data, the engineer's way isn't so hard after all, thanks to calculators. Wonder how to design that bandpass filter or wind that coil? Do the abbreviations f_{co} and h_{oe} confuse you? They, with all other common electronic abbreviations, are there. Wonder how to convert Maxwells to Webers or footpounds to kilogrammeters? These and other conversions, common and obscure, are compiled.

Let's face it: Most of us don't remember those formulas we saw on

our license exams, except the easiest. If you should need them, here they all are. It practically makes electronics math look easy.

Op Amp Circuit Design & Applications by Joseph Carr Tab Books #787, Blue Ridge Summit PA, 282 pp., $6.95.

The most popular and useful device to emerge from the development of linear ICs is the operational amplifier. Their versatility is amazing, as they are an inexpensive and convenient approximation of the "perfect" amplifier.

This new book brings together the theory and circuitry needed to apply op amps to a wide range of applications. After a thorough, well illustrated description of op amp basics, applications are presented for use in computation, test equipment, active filters, power supplies and more. There's not much you can't do, it seems, with today's op amps.

Besides the conventional op amps, exotic and newer devices are also covered, keeping the circuit designer up to date. Anyone with an interest in designing or building audio, power supply, instrumentation or other linear circuitry would do well to read this book.

Build-It Book of Miniature Test & Measurement Instruments by Robert P. Haviland Tab #792, 238 pp., $4.95.

Here is a complete guidebook for the construction of a wide range of test instruments. None of them is expensive to build, and all are compact and modern.

Complete instructions are given for all of the devices, including printed circuit layouts and parts lists. There are also chapters on general construction practices, to help your projects look professional. Newcomers to construction would do well with this book, as it is not written exclusively for the expert. Experts will still find use for the gear, though.

Included are RCL bridges, audio signal generators, general purpose test amplifiers, a Q-meter, sound level meter, and digital counter. And there are more circuits than that. Fifty measurement functions are possible with the devices described, and that's not bad for $4.95!

SOCIAL EVENTS

FLUSHING NY
JUNE 5

The Third Annual Hall of Science Radio Club auction and flea market will be held Saturday, June 5 at World's Fairgrounds, Flushing, L.I. Admission $1.00, sellers $2.00. No sellers commission but 10% fee on auctioned items. Zoo, boating, children's farm, art and science museums adjacent. Field Day goodies galore. For more information write: Box 1032, Flushing NY 11352.

HUNTINGTON WV
JUNE 6

The Tri-State Amateur Radio Association (TARA) 14th Annual Hamfest will be held Sunday, June 6th at 11:30 am at Camden Park, Rt. 60 West, Huntington WV. Talk-in W8VA/8 146.04-.64, .16-.76, and .34-.94. For more information and tickets write to: TARA, PO Box 1295, Huntington WV 25715.

WINFIELD PA
JUNE 6

The Penn-Central Bicentennial Hamfest will be held Sunday, June 6 at the Union Township Volunteer Firegrounds, Winfield PA, 11 miles south of I-80 on Route 15. Contests, auction, flea market – start at noon. Registration $2; XYL, children free, free parking. Contact W3GPR.

BELLEVILLE MI
JUNE 6

The Southeastern Michigan Amateur Radio Hamfest will be held Sunday, June 6, 1976, from 6 am till 4 pm, at the Wayne County Fairgrounds, Belleville, Michigan. 20 minutes from Detroit, 10 minutes from Ann Arbor. I-94 at Belleville Road Exit. Featuring: indoor exhibits, swap and shop, trunk sales, food and refreshments, camping space adjacent to fairgrounds available at a nominal free, and hotel and motel reservations will be available. 5 major prizes. Tickets $2 advance, $2.50 at gate. For more information and tickets write to: Hamfest, Box 1976, Belleville MI 48111. Talk-in 37/97 rpt – 52 simplex. Sponsored by: A.R.R.O.W. Repeater Inc., WR8ADH.

OLD WESTBURY NY
JUNE 6

The Electronic Flea Market sponsored by L.I. Mobile Amateur Radio Club (LIMARC) will be held Sunday, June 6, 1976 from 9am to 4 pm (rain date: June 20) at the N.Y. Institute of Technology, Rte. 25A and Whitney Lane. Admission $1 per buyer; $2 per space seller. For additional information call W2KPQ (516) 938-5661. Talk-in on 25/85.

PISCATAWAY NJ
JUNE 6

The Tri-County Radio Association Inc., flea market will be held June 6, 1976 at Nick's Grove, 318 William Street, Piscataway NJ. Opens at 10 am, admission $1, tables $4, half tables $2. Door prizes. Talk-in 146.52, 147.855/147.255. For further information call (201) 725-0778 or (201) 752-4307 or write: PO Box 412, Scotch Plains NJ 07076.

MANASSAS VA
JUNE 6

The Ole Virginia Hams A.R.C. is sponsoring its second annual Mid Atlantic area "Quality" Hamfest for Sunday, June 6, 1976, at the Prince William County Fairgrounds, Route 234, ½ mile south of Manassas, Va. Directions: take I-95 to Route 234 at Dumfries, Va., or I-66 to the Manassas exit, then south on Route 234. Talk-in on 146.37-97, 147.84-24 and 146-52 simplex. Featuring – large display and exhibit area, electronic flea market, and door prizes. For more information and advanced registrations write to: WA4GVX, 1708 Sharp Drive, Woodbridge VA 22191.

PRINCETON IL
JUNE 6

The Starved Rock Radio Club Hamfest will be held June 6 at the Bureau County Fairgrounds, Princeton, Illinois, same place as last year. Free coffee and doughnuts from 10 to 10:30 am. Camping and trailer space on a first come first served basis for a nominal fee. Official dedication of Starved Rock Repeater by ARRL officials. Advance registration, $1.50 until May 20, after that/or at gate $2.00. For more complete information, motel list, maps, etc., furnish long SASE. For reply, write: Starved Rock Radio Club W9MKS, RFD #1, Box 171, Oglesby IL 61348. (815) 667-4614.

SHAKER HEIGHTS OH
JUNE 11-13

The Midwest Affiliation of Computer Clubs (M.A.C.C.) is sponsoring the first annual Midwest Regional Computer Conference at Cleveland in June, 1976.

The event is being hosted by the Cleveland Digital Group and will take place in Shaker Heights, Ohio at the Stouffer Somerset Inn, 3550 Northfield Road. Dates are June 11, 12, and 13. Tickets are $2.00 in advance and refreshments will be available.

The event will have a Trade Show type format with each manufacturer having a booth or booths for his own use. Additional demonstrations, technical sessions, games (such as Star Trek), etc., will be going on almost continuously. We are planning on a rather large flea market and, of course, program duplication, copying and media conversion facilities will be available.

More complete information and tickets can be obtained by writing to: The Midwest Affiliation of Computer Clubs, PO Box 83, Brecksville OH 44141.

SIOUX FALLS SD
JUNE 12-13

The Sioux Falls Amateur Radio Club, Inc. and the Sioux Valley Repeater Association, Inc. will hold the 1976 South Dakota Ham Picnic in Sioux Falls on June 12 and 13 at the Sioux Empire Fairgrounds on Sioux Falls' west side, ½ mile east of Interstate 29 and the 12th Street off ramp – follow the "OSY" signs. A talk-in will be on 3950 kHz by the S.F.A.R.C. Club station, WØZWY. Members of the S.V.R.A. will provide information and assistance on the WRØACK 16/76 repeater. For further information, please send an SASE to Sioux Falls Amateur Radio Club, PO Box 91, Sioux Falls SD 57101.

ATLANTA GA
JUNE 12-13

The ARRL Southeastern Division Convention and the Atlanta HamFestival 1976 will be held on June 12-13th at Dunfey's Royal Coach Motor Hotel, I-75 at Howell Mill Road, Atlanta GA. Special HamFestival rates of $16 single, $21 double are in effect. Individual registration is $3 in advance, $4 at door; family registration $5 in advance, $6 at door. Flea market spaces (outdoors) are $5 each, first come, first served. For more information and pre-registration forms, write: Atlanta HamFestival 1976, 53 Old Stone Mill Road, Marietta GA 30062 or telephone area (404) 971-HAMS day or night.

ARNOLD MD
JUNE 13

The Maryland Mobileers Amateur Radio Club will hold its Sixth Annual Hamfest on Sunday, June 13, 1976 at Anne Arundel Community College, Arnold, Maryland. Gates open at 9 am. Registration: $2. Tailgaters: $3 plus registration fee. Drawings to be held at 3 pm. First prize: $200 Savings Bond. Talk-ins on 146.10/.70 – 146.52 – 146.16/.76.

WILLOW SPRINGS IL
JUNE 13

The 19th Annual ABC Hamfest will be held Sunday, June 13, 1976 sponsored by the Six Meter Club of Chicago, Inc. Located southwest of Chicago at Santa Fe Park, 91st and Wolf Road, Willow Springs IL. Advance registration $1.50; at the gate $2.00. Large swap row, picnic grounds, AFMARS meeting, refreshments. Advance tickets from Don Marquardt K9SOA, PO Box 79, Lyons

IL 60534 or any club member. Talk-in on 146.94 FM or WR9ABC 37-97 (PL2A).

GRANITE CITY IL
JUNE 13

The Egyptian Radio Club, Inc., W9AIU Hamfest will be held Sunday, June 13, 1976 at the club house located north of Granite City, Illinois, ¼ mile south of the Old Chain of Rocks Canal Bridge. Swapper Row, games for the kiddies, lunch served, cold drinks, ladies' white elephant sale and Bingo. Talk-in on AF9ACA 146.76. Admission free.

AKRON OH
JUNE 20

The Goodyear Amateur Radio Club WA8UXP of Akron, Ohio will hold their 9th Annual Fathers' Day (Hamfest Picnic), on June 20, 1976, at Wingfoot Lake Park located east of Akron, Ohio, one mile west of Suffield, Ohio, on County Rd. #87 and near County Rd. #43. Huge flea market, displays, swap and shop, prizes on the hour, picnic tables available. Adult and children's play area all day. Join us for an enjoyable day of entertainment. Hours: 10 am to 6 pm. Family admission $2 prepaid; $2.50 at gate. For details, tickets, map and program, write to Floyd T. Gilbert WB8ALK, 1976 Newdale Ave., Akron, Ohio 44320.

SCHEREVILLE IN
JUNE 20

The Midwest Repeater Association with the Indiana Dunes Amateur Radio Club's Hamfest will be held June 20, 1976 at the Lake Hills Senior Citizens' Picnic Grove, 8100 Austin Road, Schereville IN, from 8 am to 5 pm. Food, drinks, door prizes, etc. Talk-in 146.31-.91 (WR9ADK) or .94, .52. Tickets or more information send SASE to I.D.A.R.C., PO Box 5, Dyer, Indiana 46311.

HONOLULU HI
JULY 3-4

The Honolulu Amateur Radio Club will hold its Hamfest/Swapmeet on July 3 and 4, 1976. The Swapmeet will be held on the grounds of the Kaimuki High School, 2707 Kaimuki Avenue, Honolulu, between the hours of 0800 am and 3 pm. Charges per stall will be $2. The Hidden Transmitter Hunt will start at 0900 am on 4 July 1976. The transmitter will operate on 146.52 MHz. Participants will meet at the Pancake House, Ala Moana Center, Honolulu, prior to 0900 am for contest instructions. Registration fee will be $1 per vehicle. Prizes will be awarded to the top 3 winners. For additional information and participation in the HARC Hamfest/Swapmeet, write: George Stillman KH6AN, PO Box 7111, Honolulu, Hawaii 96821.

DUNSEITH ND
JULY 10-11

The 13th Annual International Hamfest is scheduled for July 10 and 11, 1976 at the International Peace Garden between Dunseith, North Dakota and Boissevain, Manitoba. Many prizes to be won. For more information write: Craig R. Schmidt WBØGFZ, Co-Chairman, 1976 Hamfest, Reed Hall #302, North Dakota State University, Fargo ND 58102.

SANTA MARIA CA
JULY 11

The Satellite Amateur Radio Club is sponsoring the Santa Maria Amateur Radio Picnic And Swapfest to be held on Sunday, July 11th, 1976, beginning at 12 noon at the Newlove-Union Oil Picnic Grounds on Orcutt Hill. Watch for the signs marking the turnoff, 1 mi. south of Clark Ave. on US 101. Talk-in will be on 146.52 and 7280 kHz.

The highlight of the event is the Santa Maria style barbecue, to be served at 2:30 pm. All the meat, salad, beans, bread and salsa that you can eat. Soft drinks will be available, but bring your own beer.

The main door prize is a Tempo One 80-100 meter transceiver. Other prizes, too. Swap tables available at $3.00 each.

The meal alone is well worth the drive from L.A. or the central valley. Tickets are only $5.00 for adults/$2.50 under 12, and can be obtained by sending a check made out to Santa Maria Swapfest, Route 1, Box 55A, Santa Maria CA 93454.

Please obtain tickets in advance so that enough meat can be ordered.

CHARLESTON SC
JULY 11

The Charles Towne Hamfest will be held at the Gaillard Municipal Auditorium on Sunday, July 11, 1976, in Charleston SC. Registration is $2, which includes a door prize ticket. Activities include an indoor flea market, displays, home brew contest, CW copying contest, historic tours, and a special program on the Marconi Wells Fleet Wireless Station. Saturday activities include QCWA, MARS, S.C. SSB Net Banquet, and a hidden xmtr hunt. Talk-in on 34/94 and 3915. For further information write — Charles Towne Hamfest, Box 4555, Charleston SC 29405 or check into the S.C. SSB net on 3915 at 7 pm local time.

PORTAGE IN
JULY 18

The Lake County Amateur Radio Club's 2nd annual hamfest is July 18 at the Issac Walton League in Portage, Indiana. Take I-94 to Ind. 249 exit, then north on Ind. 249 ½ mile. Tickets $1.50 advance, $2.00 at gate. Write: Herbert S. Brier W9EGQ, 409 S. 14th St., Chesterton, Indiana 46304.

TERRE HAUTE IN
JULY 18

Turkey Run Hamfest has MOVED! New location is the Vigo County Fairgrounds on Highway 41 just South of Terre Haute. There will be prizes galore, lots of flea market space under a roof, XYL Bingo, and plenty of overnight camping will be available. Presale tickets are available 4 for $5 or $1.75 ea. At the gate 3 for $5 or $2 ea. For further information or tickets write to Wabash Valley Amateur Radio Assn., P.O. Box 81, Terre Haute IN 47808.

briefs

There is resistance growing in some quarters to the **ARRL repeater coordination** plan. Many amateurs consider the precedent dangerous; there have been few repeater wars lately and they tend to get settled without outside intervention. In the most notorious case of the past year, the party causing the trouble (K4LSP) is the ARRL-recognized coordinator for Tennessee, though the offended repeater is in North Carolina — whose own coordinator considers K4LSP's behavior improper.

This year's **ITU commemoration** in May should see the first of the "N" group callsigns for domestic use. Calls like N62ITU and N38ITU are being assigned, as well as the "more conventional" ITU calls like KQ3ITU. It's not rare DX, just special events calls in the United States. While any licensee can request an ITU call, participation is somewhat limited by the $29 special license fee.

A "point of sale" **CB licensing system** is now going into operation. A form that comes with every new radio will permit self-assignment of a temporary callsign, that will become effective upon mailing the application (with fee) to the FCC. The postal receipt will validate the authorization.

Hopefully this system will help, not hinder, the FCC's attempts to reduce the licensing delays in the Amateur Service. While Novice licenses are being processed in about two months, some are taking longer and the percentage of lost applications is still high.

The FCC has ruled that the **telephone companies** may no longer prohibit interconnection of privately purchased equipment to the phone system. As of May 1, you could attach privately owned telephones and similar non-hostile devices to your telephone line without paying a special rate for an interconnect coupler.

Certain "amateur" equipment companies are doing a big business in sales of HF SSB equipment to the **27 MHz "HF" operators**, who operate from 27.3 to the bottom of ten meters. The current published roster of HF International members lists about 40,000 names; bootleg registration "calls" are now well into the "HFC" series. Current amateur worry is that the "220 MHz synthesized CB transceiver" advertised by National Radio Institute in other ham magazines will become popular among CBers — even though 220 MHz CB is a dead issue.

Lloyd (W6KG) and Iris (W6DOD) Colvin have been cruising the South Pacific on a **YASME Foundation DXpedition**. After their successful C21NI operation on Nauru, they went to YJ8, New Hebrides, where they were denied entry because they didn't have a visa — they had been told that they didn't need one. They had to move on to New Caledonia.

SLATER MO
JULY 24-25

The Antique Aircraft and Amateur Radio Show will be held Saturday and Sunday, July 24 and 25, 1976 at the Slater Memorial Airport. Registration $1 in advance: $1.50 at the door. Buffalo burger feed Saturday night and Sunday noon. Talk-in 3963 kHz, 146.94 and 146.28/.88. For additional information and advance tickets write Dale Beilsmith WØKNF, 807 North Broadway, Slater MO 65349, (816) 529-2173.

CROSSVILLE TN
JULY 24-25

The Oak Ridge Amateur Radio Club, Inc., Annual Crossville Hamfest will be held in Crossville TN on July 24-25, 1976 at the Cumberland County Fairgrounds. Technical forums will be at the Holiday Inn on July 24 and the banquet will be at Holiday Hills Country Club on Saturday night with a Breeder Reactor Program planned. Sunday, July 25, features a picnic, flea market, raffle of many valuable prizes, and "eyeballing your friends" at the fairgrounds.

CANTON OH
JULY 25

The Tusco Amateur Radio Club and the Canton Amateur Radio Clubs are holding their Second Hall of Fame Hamfest on July 25, 1976. It will be held at the Stark County Fairgrounds, Canton, Ohio. This weekend, by the way, is the weekend of the National Pro Football Hall of Fame Football Game and Parade.

FLAGSTAFF AZ
JULY 30-AUG 1

The Ft. Tuthill Hamfest will be held July 30-31 and August 1 at Flagstaff, Arizona at Coconino County Fairgrounds across I-17 from airport. R-V and tent camping. Three days in the tall cool pines. Swapmeet, tech sessions, contests, prizes, pot luck, and exhibits. Talk-in 146.22/82, 146.34/94, 146.52 and 3992 kHz.

Continued on page 156

Arny Cain WB4FDQ
2306 South Ruffner Road
Melbourne FL 32901

Handy Dandy Soldering Iron Cooler Offer

Hey baby, how does that title grab you? If you are at all like me (and you must be something like me or you wouldn't be reading this article, let alone the magazine), you enjoy finding solutions to the nagging little everyday problems found in our favorite hobby. The gadget in the photographs is my solution to a little problem that has bugged me for years. I am sure that there are many of you who have been faced with the same irksome situation: what to do with the mini-iron that you need for working on transistors and ICs, when the damn thing is up to working temperature and you need the hand to do something else.

In other words, where can you put it down? Like you, I've tried ashtrays, saucers, boards with nails, etc. Well, I finally decided to do something about it, and I don't mean buy a factory-made stand. Oh, I could have done it that way but for two reasons. First, I'm cheap! (Besides, it's more fun figuring it out for yourself.) Second, the factory-built stands only give you a place to put the pesky iron down, and I figured that if I was going to build a holder, I might just as well build one that controlled the temperature of the iron as well. As you may have guessed by now, I'm one of those lazy guys who never buys what he can build, and never builds a gadget to do one job if it can be made to do more.

A quick look at the photos will show that this is a project built one hundred percent from genuine junk box parts, and not the kind you have to buy. The base is an old 3"x5"x2" steel black crackle finished (at least it used to be) box that had been used for at least five or six other projects before finally finding respectability as the centerpiece of the workbench. Large green and red jeweled pilot lights of the 7½ W 115 V type are used in the top to show that the device is on (green), and that the soldering iron is on high heat (red), when it is withdrawn from the cradle. I didn't really need the lights, but I

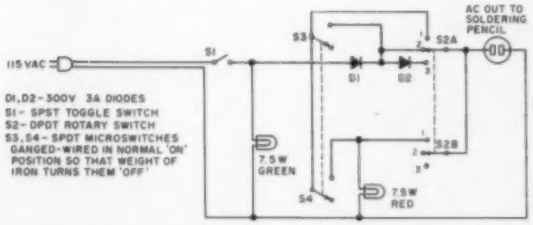
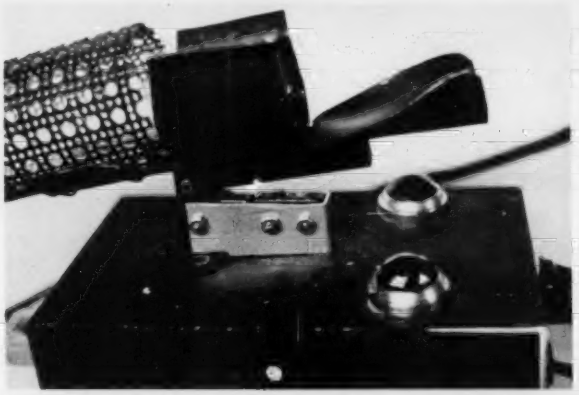
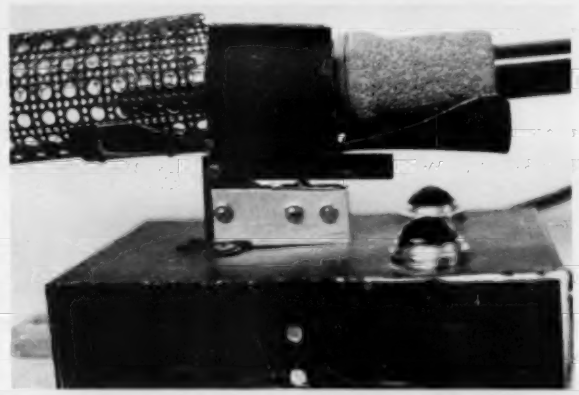


Fig. 1. D1, D2 – 300 V 3A diodes; S1 – SPST toggle switch; S2 – 2PDT rotary switch; S3, S4 – SPDT microswitches gang-wired in normal ON position so that weight of iron turns them off.





have a lot of them and they filled up two holes in the top of the box that needed filling.

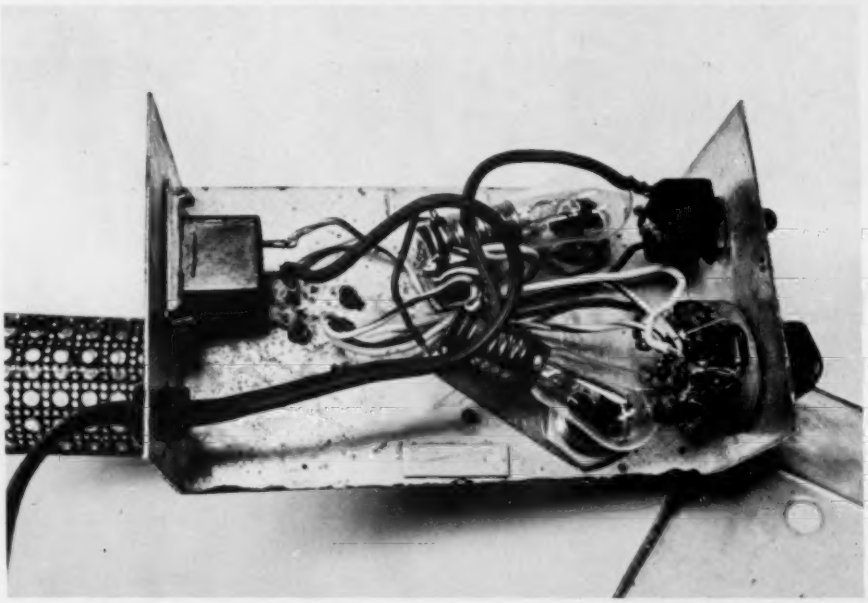
The cradle for the iron is made from scrap aluminum, and the heat shield is a piece of scrap perforated aluminum sheet rolled into a tube and fastened to the cradle. This assembly is fastened to a piece of ¼" square steel rod. I drilled two holes through the cradle and the square rod and hit it with two pop rivets. The rod is now drilled at a point just aft of its balance center so that when the iron is removed it will tilt forward of its own weight. I made a little three-sided post out of scrap aluminum and pop-riveted it to the top of the box (see close-up photo); this provides the pivot point for the cradle and also a place to fasten the microswitches. In my version (I'm sure that there is no one reading this who will ever build a carbon copy), the microswitches are turned off by the weight of the iron on the cradle. As you will note in the schematic, this opens the circuit across a diode, thereby cutting down the heat on the iron when it is at rest and shorting it out when the iron is removed. Removing the iron also lights the red signal light showing that higher heat is being applied and also informing you when you don't put the iron back in the cradle properly.

Of the two switches on the front, the toggle switch controls line voltage, while the double pole triple throw rotary switch selects one of three modes. Number one position is direct line voltage or high heat. In this position the iron is connected at all times directly to the 115 V ac line. In number two position the iron is in series with a 300 V 3 A diode while in the cradle, and directly to the line voltage when it is lifted to be used. The third and last position puts the iron in series with a diode at all times, cutting the heat still further. I have found that the third position is best for soldering tiny leads close to the bases of delicate solid state devices such as HF transistors. The number two position is the one most in use on my bench, since it keeps the iron reasonably hot, but not at high temperature, and within five or six seconds after lifting it from the cradle it is up to full working heat.

The number one position could, quite frankly, have been eliminated, but the switch position was there so I just went ahead and wired it in. It is rarely used because it causes tips to oxidize very quickly. The wiring diagram is, hopefully, self-explanatory. I must confess that this simple tool (gadget) is the most used addition to my bench that I have ever built. It has been in uncomplaining constant use for over two years, and only my natural proclivity for procrastination has kept me from sharing it with you before this.

This article is not an exact plan for construction, as should be obvious, nor is it intended as such. As I said in the beginning, if you are anything like me, you will have your own built-in prejudice against doing a carbon copy of anything. So just use the idea as a little prod to the grey cells and come up with your own solution. I'm sure that there are many other ways of doing this, and probably most of you can think of an even better way.

Have at it; there are too many soldering irons sitting around cold in the first place, so put them to work. ■



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Perfect CW

--drive 'em crazy with the Keycoder I

Fig. 1. Keycoder I built by W9UBA.

Fig. 2. The author's version of Keycoder I.

The CW keyboard keyer described here should appeal to any amateur who wants to increase his code speed and send letter-perfect, space-perfect CW — or to anyone seriously interested in teaching or learning the code.

Although there are a lot of articles and letters in ham magazines about amateur radio clubs teaching code, the use of a keyboard keyer as a teaching aid seems to have been neglected, possibly because most such keyers are quite expensive. Keycoder I, however, can be built for $60-$75, *including keyboard,* and would make an excellent club project. When used as a code teacher, the keyboard keyer has the following advantages to recommend it:

- Perfect code — The learner always hears correctly formed characters
- Variable speed — Character rate is continuously variable from about 5 wpm to over 50 wpm (unlike code records or cassettes)
- Repetition — The student can practice by himself the characters that he is having difficulty with (again unlike recorded code lessons)
- Instructor need not know CW! — A unique feature — XYLs, harmonics, and other non-hams can help the novice learner without themselves knowing the code

Other technical advantages of Keycoder I are:

- TTL Logic — 9 inexpensive and readily available ICs, plus about 2 dozen discrete components, make up most of the circuit; 7 toroidal cores and another couple of dozen discretes provide an encoding matrix that would require over 100 diodes
- Rf Insensitive — With TTL ICs and only minimal bypassing, no rf problems have been experienced with the two units illustrated
- Self-contained — Power supply, logic, monitor (with tone and volume controls), and output circuit are all contained within the keyboard case
- Simple construction — A commercially available IC board makes wiring the logic easy (simple point-to-point wiring with no critical steps)

Fig. 1 is a close-up photo of the unit built by Charles H. Haut W9UBA (New Berlin WI), who is the author of this project if not of the article, and Fig. 2 shows my keyboard with a few control variations.

Keycoder I is a TTL adaptation of the Touchcoder II keyboard keyer described in the July 1969 issue of *QST*. That article contains a very good discussion of the circuit theory and of the toroidal core transformers used, so this information will not be repeated here. Our theory discussion will take you on a tour of the TTL-version schematic diagram (Fig. 3). For convenience of discussion, the schematic is separated by dashed lines into the following six areas representing functional blocks: (1) dot generator, (2) dash generator, (3) shift register, (4) encoding matrix, (5) monitor, and (6) output stage. The discussion that follows will be so divided also, with some necessary overlapping. On the schematic diagram, the logic state H ("1") or L ("0") is shown for the output of each IC. These states are for static conditions, when no character is being generated.

Dot Generator

IC1 is a 555 integrated circuit timer set up as a triggered multivibrator. The frequency of the multivibrator (and hence the code speed) is determined by the

Character	Flip Flops FF7	FF6	FF5	FF4	FF3	FF2	FF1
A					X	X	
B			X				X
C			X		X		X
D				X			X
E						X	
F			X		X		
G				X		X	X
H			X				
I					X		
J			X	X	X	X	
K				X	X		X
L			X			X	
M					X	X	X
N					X		X
O				X	X	X	X
P			X		X	X	
Q			X	X		X	X
R				X		X	
S				X			
T						X	X
U				X	X		
V			X	X			
W				X	X	X	
X			X	X			X
Y			X	X	X		X
Z			X			X	X
1		X	X	X	X	X	
2		X	X	X	X		
3		X	X	X			
4		X	X				
5		X					
6		X					X
7		X				X	X
8		X			X	X	X
9		X		X	X	X	X
0		X	X	X	X	X	X
.	X	X		X		X	
,	X	X	X			X	X
?	X			X	X		
/		X		X			X
-		X	X				X
$\overline{AR}$		X		X		X	
$\overline{SK}$	X	X		X			
$\overline{AS}$		X				X	

Table 1. Character generation table. Xs indicate the shift register flip flops that must be set to form a given character (also the toroidal core transformers that the wire for that character must pass through).

values of R1-R3 and C1, and is adjustable by means of R2. The duty cycle is 50% for all practical purposes, thus providing dots and character interelement spaces that are equal. (Of course other R and C values can be substituted. Those on the schematic are the ones in W9UBA's unit; I used R1 = 1k, R2 = 50k, R3 = 15k, and C1 = 2.2 uF, with equally satisfactory results.)

R4, R5, and CR1 are bias components that are necessary to make the first dot the same length as following ones. This is because normal timer operation charges and discharges C1 between 1/3 and 2/3 vcc. However, on the very first cycle, C1 is discharged, and has to charge from 0 volts to 2/3 vcc. The resistors, which are merely a voltage divider across the power supply, maintain a bias voltage on C1; CR1 prevents interference with the normal triggering of IC1.

The output of the dot generator (pin 3) is routed to both the output circuit and monitor through two sections of IC4 (NOR gates); the first section is a summing gate (discussed later), and the second section disables the output (and monitor) for the duration of 3 dot lengths at the completion of each character, to provide automatic character spacing.

Dots are generated when pin 6 of IC1 goes low, which occurs only when pin 6 of IC3 goes low.

Dash Generator

As with other keyers (both keyboard and manual), Keycoder I forms dashes by filling in the space between two successive dots, thus producing dashes exactly 3 units long. The circuit action is as follows: FF8 is a "D" type flip flop that clocks on the rising edge of pulses applied to pin 11. When no dashes are called for, pin 3 of IC3 applies a "1" to the data input (pin 12) of FF8, and the Q output of this flip flop is high and the $\overline{Q}$ output is low. FF8 is clocked each time a dot is generated but does not change state as long as the IC3 output is high. When a dash is required, pin 10 of IC4 goes high, causing pin 3 of IC3 to go low, and FF8 is readied to toggle when it is clocked. For a dash to be formed, two dots are generated. The first dot is passed through to the output but also clocks FF8. The $\overline{Q}$ output of FF8 then goes high and holds the summing gate portion of IC4 open after completion of the first dot. After arrival of the first dot, pin 1 of IC3 also went low, readying FF8 to toggle back to its static state. FF8 is clocked by the second dot, and its $\overline{Q}$ output goes low again, but the second dot now holds the summing gate open. Hence, the summing gate is open for a period of two dots and the space between them, and a 3-dot-length dash is formed.

This same sequence of events takes place at the completion of each character to automatically provide a 3-dot-length space between characters, but this terminal dash is made silent by applying a high to pin 12 of IC4.

Shift Register

As shown in Fig. 3, the shift register portion of the schematic consists of "D" type flip flops FF1 through FF7, two sections of a triple 3-input NAND gate (the third section isn't used), the remaining two NOR gate sections of IC4, and two gates of a quadruple 2-input NAND gate IC (the fourth section isn't used). In this mechanization, the 3-input NAND gates serve an OR function, one

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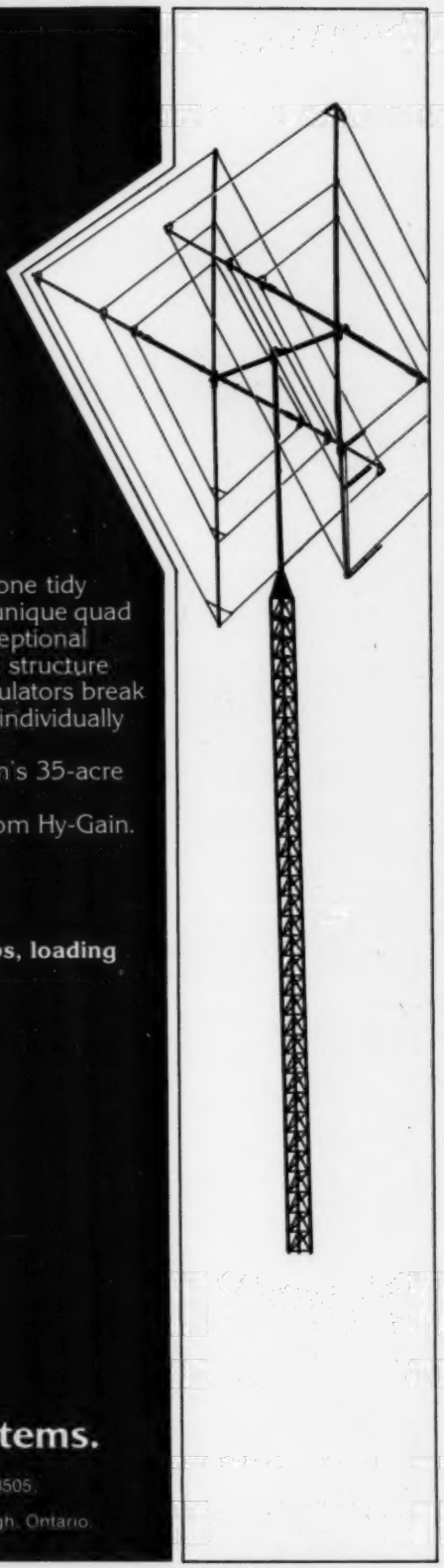

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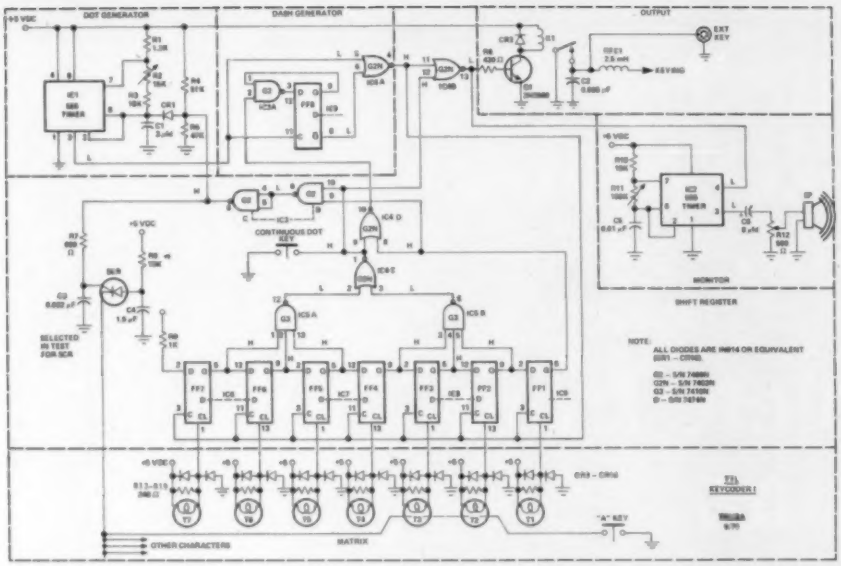

Fig. 3. Schematic.

section of IC4 is used as an AND gate, and pins 4, 5, and 6 of IC3 are really only an inverter, so things aren't entirely as they seem.

The flip flops are all "D" types, and are packaged two per IC. Note that the second flip flop of IC9 is the FF8 previously mentioned. Only the Q outputs (pins 5 and 9) are used, and these are a logic high in the static condition. For our purpose, the flip flops are "set" (Q = "0") by applying a low to their "Clear" terminals (pins 1 and 13). Shifts occur from left-to-right only.

With the foregoing in mind, let's leave the hardware mechanization for a bit and refer to the Character Generation Table (Table 1). Here, the "X"s in the horizontal rows represent the dashes in a character, the "X" furthest to the left is a "silent dash," and the blank spaces to the right of the silent dash represent dots. Although data is shifted left-to-right, we "read" Morse characters in this table from right-to-left. For example, in the row for the letter "P", starting from the extreme right we see a blank space which represents a dot. Moving to the left we find two "X"s, which we know are dashes, followed by another blank space for a dot, and finally another "X" (which is the silent dash to separate this character from the next). In terms of the hardware, the "X"s represent the flip flops that are simultaneously set when a keyboard key is struck, and also the toroidal cores that must be strung to generate that character.

The character generation scheme, which was originally proposed by James B. Ricks W9TO (Evanston IL), has three rules:

1. If only one flip flop is set, a number of dots will be generated, the number being one less than the number of the flip flop set. For instance, in the row for "S", only one "X" appears, in the column headed FF4; therefore 3 dots will be generated.
2. If FF1 *and* any other flip flop are set, a dash will be generated.
3. If only FF1 is set, a silent dash is generated.

As each dot or dash is completed, all entries in the appropriate row of the table are shifted one column to the right, and another of the three above rules is applied. For the letter "B", initially the conditions for rule 2 are met, and accordingly a dash is generated; after one shift to the right, rule 1 applies, and three dots are generated; these three dots produce three more shifts, after which rule 3 comes into effect and the character is completed, followed by a 3-dot-length space.

Returning to the schematic, observe that the static state for the flip flops is for their Q outputs to be high. This results in the other gates in the register being forced to the logic states shown, ending up with pin 6 of IC3 being high and the dot generator disabled. Through a process to be described later, one or more of the flip flops is set each time a key is struck. The resulting lows on the flip flops cause the outputs of one or both sections of IC5 to change state and, in turn, pin 1 of IC4 and pins 8 and 6 of IC3, thus starting the dot generator. If pin 5 of IC9 goes low and the Q output of any other flip flop also goes low (rule 2), pin 10 of IC4 will go high, and a dash will be generated; otherwise a dot will be formed. The dot or dash causes pin 4 of IC4 to go from a high to a low. This pin is connected to the clock inputs (pins 3 and 11) of the shift register flip flops, but a high-to-low transition does not affect a "D" type flip flop. However, when the dot or dash is completed, pin 4 of IC4 again goes high, and the low-to-high transition does clock all of the flip flops causing a right shift. That is, the Q output of each flip flop assumes the logic state that its left-hand neighbor had before the clock pulse. The resulting new set of Q outputs now initiates another dot or dash which, in turn, produces another clock pulse to shift the register to the right again, and so on until only the output of FF1 is low. This is the condition (according to rule 3) to generate a silent dash. What actually happens here is that FF1 turns on the dot generator, but since the other flip flop outputs are all high, pin 1 of IC4 is high and provides the output inhibit signal to pin 12 of IC4. Note that the silent dash creates another clock pulse that shifts the "1" output of FF2 into FF1, thus ending the character cycle and restoring the static condition.

In addition to starting and stopping the dot generator, pin 6 of IC3 also activates the gate of the SCR that provides current drive to the keyboard encoder circuitry. Therefore, the keyboard is locked out during character generation, but is automatically re-enabled as soon as the character is completed. This feature also provides automatic character repeat: A character is repeated, with 3-dot-length spaces between, as long as a key is held down.

This is a fine operating feature for sending words with double "o"s and double "l"s, etc., but is not so hot for sending double "e"s at high speed. If desired, automatic repeat can be disabled by reducing the drive on the SCR.

Note the "continuous dot" key connected between pin 1 of IC4 and ground (this is the switch labeled "DOTS" in Fig. 2). This is depressed and held down while adjusting the SPEED control to initially set the keyer to the desired code speed. The continuous string of dots resulting from holding down this switch represents the maximum sending speed for a given SPEED control setting. Holding down the "E" key also produces a string of dots, but with 3-dot-length spaces between each one.

Keyboard Encoding Matrix

Toroidal core transformers, driven by an SCR, are used for encoding keyboard contact closures to set the shift register flip flops in accordance with the Character Generation Table. These transformers are made by winding 10 turns of #30 enameled wire around half inch diameter powdered ferrite cores. The windings are equally spaced around the circumference of each core, but the spacing is not at all critical (see Fig. 4). Only cores with high permeability, such as those in the Parts List, should be used. The "one turn primary" of the transformer is simply a length of the same type of wire passed through the center of the cores appropriate to the character to be formed (per the Character Generation Table). One end of this primary is soldered to the keyboard contact of a given character, and the other end to the cathode of the SCR. There is, of course, one such primary for each of the 44 CW characters in the table, and several pass through each core. With #30 wire the cores don't get too crowded, and there is no effect on the cores by wires that pass around the cores but don't go through them (see close-up photo of the logic board, Fig. 5).

One end of the secondary winding of each transformer is connected directly to Keycoder's +5 V dc regulated power supply, and the other end to the "Clear" terminal of each shift register flip flop. When the SCR fires, a high current pulse passes through the one turn primary connected to the key pressed. This pulse induces a very short duration high voltage (up to 15 V) pulse in the secondaries of the cores it passes through. These pulses are polarized in opposition to the +5 V applied to the secondaries and drive them to ground potential, thus setting the flip flops to which they are connected. The resistor across each secondary is for loading to suppress transients, and probably wouldn't really be needed (but is cheap insurance). Its value isn't critical. The diode in parallel with the resistor clamps the voltage to +5 V to prevent possible damage to the flip flop from too high a voltage spike. This probably isn't actually required either, but W9UBA and WA9VGS are cautious fellows. The diode in series with the clamping diode to ground prevents the flip flop "Clear" from being driven below ground (negative voltages should never be applied to TTL ICs).

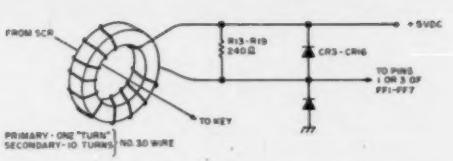

Fig. 4. Toroidal core transformers used for encoding.

The SCR circuit works like this: C4 is charged up to the power supply voltage through R8. The gate of the SCR is open since pin 6 of IC3 is high, but current cannot pass because the keyboard key is open, breaking the cathode connection to ground. When a key is struck, the circuit is complete and C4 discharges almost instantaneously (the actual discharge time depends upon the time constant of C4-R8). This discharge produces the high current pulse to fire the core secondaries and set the flip flops. The instant a flip flop is set, pin 6 of IC3 goes low, closing the SCR gate, and C4 begins to recharge for the next character. The closed gate ensures that the keyboard is locked out until the character being generated is completed and IC3 pin 6 goes high again. C3 is simply a filter capacitor to prevent transients from triggering the SCR.

Monitor

IC2 is also a 555 IC timer connected as a triggered multivibrator. The bias components used in the dot generator are not necessary here since the IC is oscillating at audio frequencies. None of the R or C values are critical and can be chosen to suit your preferences or what you have available. With those shown, the monitor produces

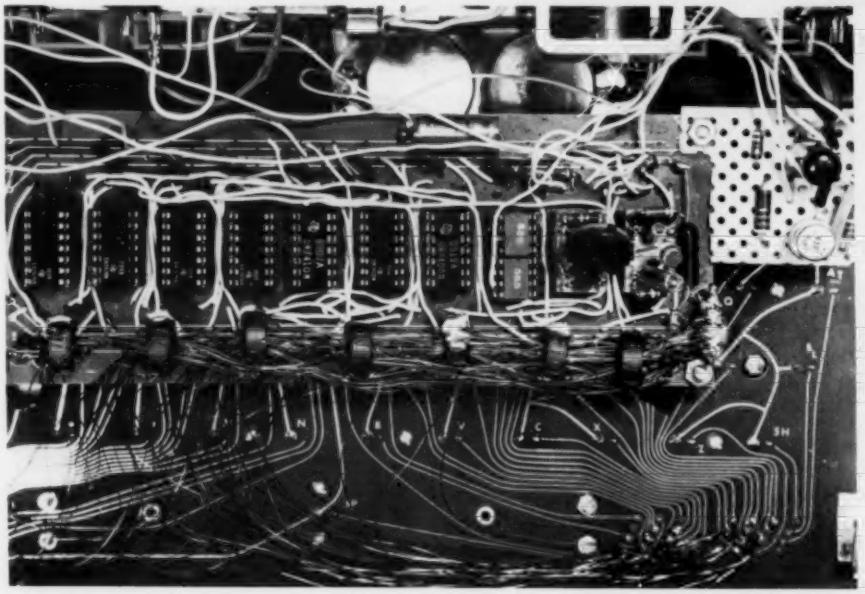

Fig. 5. Close-up view of the logic board.

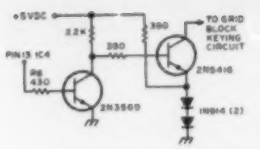

Fig. 6. Transistor keying circuit for Keycoder I.

tones from about 50 Hz to several thousand Hz, adjustable by R11. Of course R11 can be a fixed resistor if you'll settle for a single tone. C6 and R12 form the simple but adequate volume control. When set at its low end, R12 completely silences the monitor, and at the high end the IC will drive a 2"-4" speaker to a volume adequate for a medium-sized room. In the dot generator, the "Reset" terminal (pin 4) was tied to +5 V dc and the IC was triggered on and off via pin 2. In the monitor, however, we switch IC2 on and off via pin 4, since our driving signal (pin 13 of IC4) is low in the off state and high in the on state.

If Keycoder I is to be used exclusively with rigs that have a sidetone, obviously the monitor could be eliminated completely, but for the small number of components involved it's nice to have the unit completely self-contained for code practice without connection to a rig.

Output Circuit

The TTL output of Keycoder I can be used to drive either a keying relay, as shown in Fig. 3, or a PNP power transistor, if you can find one with ratings adequate for the keying circuit of your rig. (We found such transistors very hard to find; W9TO very kindly provided a list of suitable transistors, with their voltage ratings, which is appended to the Parts List.)

In the relay circuit shown in Fig. 3, Q1 can be any small NPN audio transistor (I used a HEP 728 with R6 = 2200 Ohms). The value of R6 can be changed to optimize the base drive if you substitute for Q1. For K1 I used a Griggsby-Barton 831C-2, which is packaged in a 14-pin DIP package and includes a protective diode (CR2). This relay is both small and completely silent, but is relatively expensive (about $5), and its contacts will only handle about 125 mW. However, this was adequate to key my Kenwood TS-520 transceiver (keying current 10 mA at 12 V). A better choice would be a surplus reed relay, such as listed in the Parts List. These are quite inexpensive (2/$1), and will handle 500 mA or better. W9UBA has used one of these relays to key his Drake T4X transmitter, Hallicrafters SR160, and several Heathkit rigs, without any difficulty.

C2 and RFC1 are for filtering any rf out of your rig's keying circuit line, and may or may not be needed depending upon how "clean" your rig is. Without either filtering component in the circuit I "froze" the contacts of one IC relay after several hours of troublefree sending, but have piled up several dozen operating hours without any relay problems after adding C2 (I still have no choke in the keying line).

Fig. 6 shows the circuit for transistor keying. Again, Q1 can be any NPN audio transistor. W9UBA has both a reed relay and the transistor shown in Fig. 6 connected in parallel in the output of his keyer, and switches back and forth between the two. Most of his on-the-air contacts have reported no discernible difference between the relay and transistor keying.

Construction

The keyboard unit is enclosed in a rugged and handsome case that is spacious enough for all of Keycoder's component parts. It was obtained from Meshna Electronics (#SP-153-L) for $35, plus shipping charges on 7 lbs. from Lynn, Mass. It is built on a heavy cast iron frame, and is trimmed in leatherette and imitation walnut grain sheet metal. The keys are magnetic reed type, very smooth, with about 3/16" travel. An added bonus in this assembly is the 10 rectangular switch positions (as seen in Fig. 1). Five of these are dummies — the plastic switch caps are in place but there is no switch beneath them — and I removed them and used the space for mounting 3 control pots (Fig. 2). Four of the other 5 switches are momentary action DPDT switches, and the fifth (labeled "PWR" in Fig. 2) is a DPDT Push-On/Push-Off switch. The two switches on the extreme right have screw-base "grain-of-wheat" light bulbs installed in sockets inside the translucent caps. I wired one of these, through a 20 Ohm, 1 Watt dropping resistor and the second set of "PWR" switch contacts to the power supply, to serve as an on-off indicator. W9UBA accomplished the same purpose by installing a red LED in a hole drilled in one of the switch caps (Fig. 1). There are also plenty of unused key positions on the keyboard (SPST), so you should be able to mechanize any control setup you like without additional switches.

There is a diode matrix circuit board just beneath the bottom cover of the key-

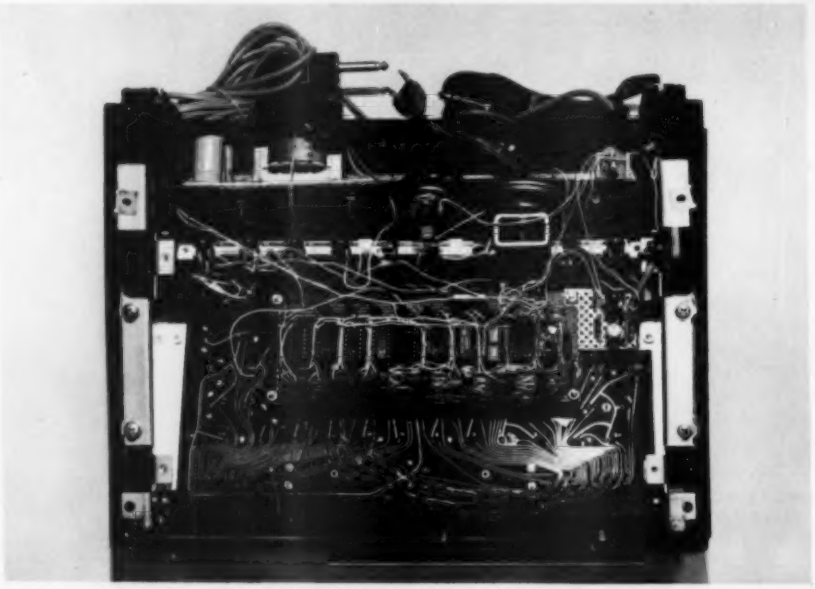

Fig. 7. Interior of W9UBA's Keycoder I.

board case. This board contains about 160 diodes and several dozen 33k resistors that can be added to your junk box (although the leads are awfully short). This board is attached to the case with a couple of screws and two multiple-lead ribbon cables that are easily removed. Beneath this discarded diode board is the key contact board, with all of the key contacts nicely labeled. Half of the foil patterns from the key contacts go to solder terminals grouped together at the bottom left-hand side of the board, and half lead to similar terminals at the bottom right. I soldered the core primary wires directly to the key contacts wherever they were on the board, while W9UBA made these connections to the bottom sets of terminals, resulting in shorter wire runs and a neater appearance (see Fig. 7).

The 9 integrated circuits, the SCR, and their associated discretes were all mounted in DIP sockets on a Radio Shack Universal Display Board (P/N 277-108). This board is predrilled for 10 14-pin DIPs, and etched with solder pads for the DIP connections and 8 separate buses running the length of the board, 4 on each side of the DIP patterns. These buses were used for +5 V dc, ground, SCR common, and the flip flop clock line. We both used #22 hookup wire for all connections; W9UBA ran his wires on the top side of the board while I made most of my connections on the foil side. Either way, this board saves a lot of building time compared with vectorboard construction or laying out and etching a PC board. The board measures about 2½" x 6¾" and costs $3.

Since the 555 ICs have only 8 pins, both of them can be mounted in one 16-pin socket; the leftover sockets can then be used for mounting the SCR and 555 discretes. The toroidal core transformers and their diodes and resistors are also mounted on the board, beneath the row of ICs (as seen in Fig. 5). The cores are wound and soldered into the circuit, but the leads are left about ¾" long. Any one of the primary wires connected to the SCR is then strung through each core before it is mounted and the wire is grounded; if nothing happens, the core polarity is incorrect and the long leads permit it to be turned 180°. When a core is operating correctly, it is glued to the board with a drop of Duco cement. Stringing the primary wires through the cores will be easier if the cores are mounted so that their openings are in a reasonably straight line.

The values of R7-C3 and R8-C4 required some juggling to get reliable SCR operation. The most severe test of SCR and core operation is generating the figure "0", since 6 flip flops have to be set simultaneously to produce this character. If you have difficulty generating "0"s, or with repeat operation, vary the values of the above components, and/or try connecting R8 to the unregulated output of the power supply to get a higher voltage and hence more current.

All the integrated circuits were bypassed with .01 uF disc capacitors from +5 V dc to ground, at the buses right opposite each IC. These capacitors are visible at the top of the board in Fig. 5. In addition, each side of the power supply transformer primary is bypassed to ground with .001, 400 volt capacitors. The all-metal, completely enclosed keyboard case provides good shielding and also contributes to the lack of rf interference.

Fig. 3 does not show the power supply, since the keyer's power requirements are reasonably uncritical and the builder will probably wish to fabricate his supply with whatever parts he has available. The Keycoder draws about 100-125 mA and the +5 V should, of course, be regulated. We decided to build our supply based on the Radio Shack 5 Volt Regulated Power Supply PC board (P/N 277-102, price $1.49). This board measures only 1¾" x 3¾", and can accommodate whatever parts you have or whatever circuit variations you wish to make. Fig. 8 is a schematic of the power supply with the parts values as specified by Radio Shack. In this configuration, the supply is rated at 1 A. The power supply is mounted in the upper left-hand corner of the case in W9UBA's unit, as shown in Fig. 7.

Parts List

IC1-IC2	555 Integrated Circuit Timer
IC3	Quad 2-input NAND gate (SN 7400)
IC4	Quad 2-input NOR gate (SN 7402)
IC5	Triple 3-input NAND gate (SN 7410)
IC6-IC9	Dual "D" Flip Flop (SN 7474)
SCR	2N889, or equivalent
Q1	2N3569, HEP 728, or equiv. NPN audio transistor
Q2	2N5416 PNP high voltage transistor, or equiv. (see accompanying table)
CR1-CR16	1N914 switching diode, or equivalent
C1	3 uF, 15 V electrolytic capacitor
C2	0.005 uF, 200 V capacitor
C3	0.022 uF, 15 V capacitor
C4	1.5 uF, 15 V electrolytic capacitor
C5	0.01 uF, 15 V capacitor
C6	8 uF, 15 V electrolytic capacitor
R1	1.2k, ¼ W resistor
R2	15k miniature potentiometer, audio taper
R3	10k, ¼ W resistor
R4	51k, ¼ W resistor
R5	47k, ¼ W resistor
R6	430 Ohm, ¼ W resistor
R7	600 Ohm, ¼ W resistor
R8	10k, ¼ W resistor
R9	1k, ¼ W resistor
R10	10k, ¼ W resistor
R11	100k miniature potentiometer, audio taper
R12	500 Ohm miniature potentiometer, audio taper
R13-R19	240 Ohm, ¼ W resistor
RFC1	2.5 mH rf choke
Reed Relay	Meshna Electronics #SP-37A, SPST ½ A contacts, 3-6 V coil
Toroids (7 required)	Order from Amidon Associates, 12033 Otsego St., No. Hollywood CA 91607

High Voltage PNP Transistors for Keying Service

Number	Vcbo
2N398A*	105
2N1275	100
2N1476	100
2N1654	100
2N1655	125
2N1656	125
2N2042A*	105
2N2043A*	105
2N2551	150
2N2590	100
2N2591	100
2N2598	125
2N2599A	125
2N2600A	125
2N3062	90
2N3063	90
2N3064	110
2N3065	110
2N3224	100
2N3413	150
2N3495	120
2N3497	120
2N3841	100
2N3842	120
2N3930	180
2N4028	100
2N4357	240
2N4888	150
2N4889	150
2N5400	130
2N5401	160
2N5415*	200
2N5416*	350
2SA305	125
2SA429	150
2SA510	110
2SA511	90
2SA516A	120
2SA637	150
2SA639	180
2SA685	150

*Germanium transistors, all others silicon.

Referring again to Fig. 7, the output transistor and its driver and associated resistors are mounted on a scrap of vectorboard just to the right of the logic board, and the reed relay is just above the vectorboard, mounted to a partition added to the enclosure. The monitor speaker is mounted on the other side of this partition (beneath and to the left of the relay).

The volume, tone, and speed control potentiometers have to be miniature types if they are to fit in the area shown in Fig. 2. The pots are mounted to a small piece of thin aluminum sheet, which is held firmly in place when fitted between the keyboard assembly and the outer case. W9UBA used full-sized pots mounted under the row of keyboard switches, as shown in Fig. 1. Also note in this photo the sub-miniature thumbwheel type pot mounted in a rectangular hole cut in the switch cap (extreme left-hand one).

The speed control range can be increased at either the low speed end or the high speed end, or both (by altering the values of R1-R3 and C1), but resolution will become poor if too large a speed range is attempted, and it will be difficult to accurately repeat a given speed setting. Two switch-selected pots could probably be used to obtain a greater range of speeds without sacrificing resolution. Audio taper pots should be used for speed, tone, and volume control.

Operation

Both W9UBA and I have had several compliments on having a "gud fist" before informing our contacts that we were using a keyboard keyer. More important, we estimate that our CW speed increased 5-10 wpm within 3 weeks after having our Keycoders on the air. We believe this is due, in part, to hearing perfect code as we are sending, and in part to the natural tendency to send faster, since it's so easy (thus unintentionally inviting a higher speed QSO).

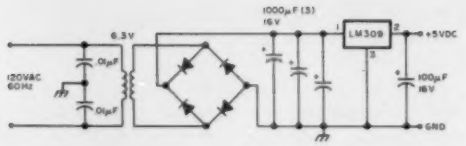

Fig. 8. Schematic of +5 V dc regulated power supply.

It takes very little practice to get the rhythm of typing on a keyboard keyer, and you don't have to be a good typist. Once you know where the characters are on the keyboard, 20 wpm seems incredibly slow, even for a "hunt-and-peck" typist. A good typist must learn to allow enough time for long letters, such as "q" and "y", to be completed before hitting the next key, and a shorter time for letters like "e" and "i", but with just a little solo practice you'll be ready to go on the air. It was originally thought that a 2 or 3 character memory, and/or a space bar mechanization, would be added to Keycoder I, but operation without these features has been so good that it has been decided to forego this additional circuitry.

In addition to W9UBA's design work, moral support, encouragement, and help with parts procurement, the assistance of three others should be acknowledged: James D. Stenseth K9CML (Franklin WI) and Mr. Ray Young both helped with design details, and on-the-air contacts and letters from W9TO were much appreciated. ■

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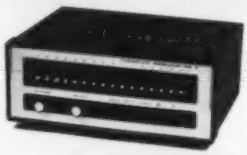

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The Mini-Mite Allband QRP Rig

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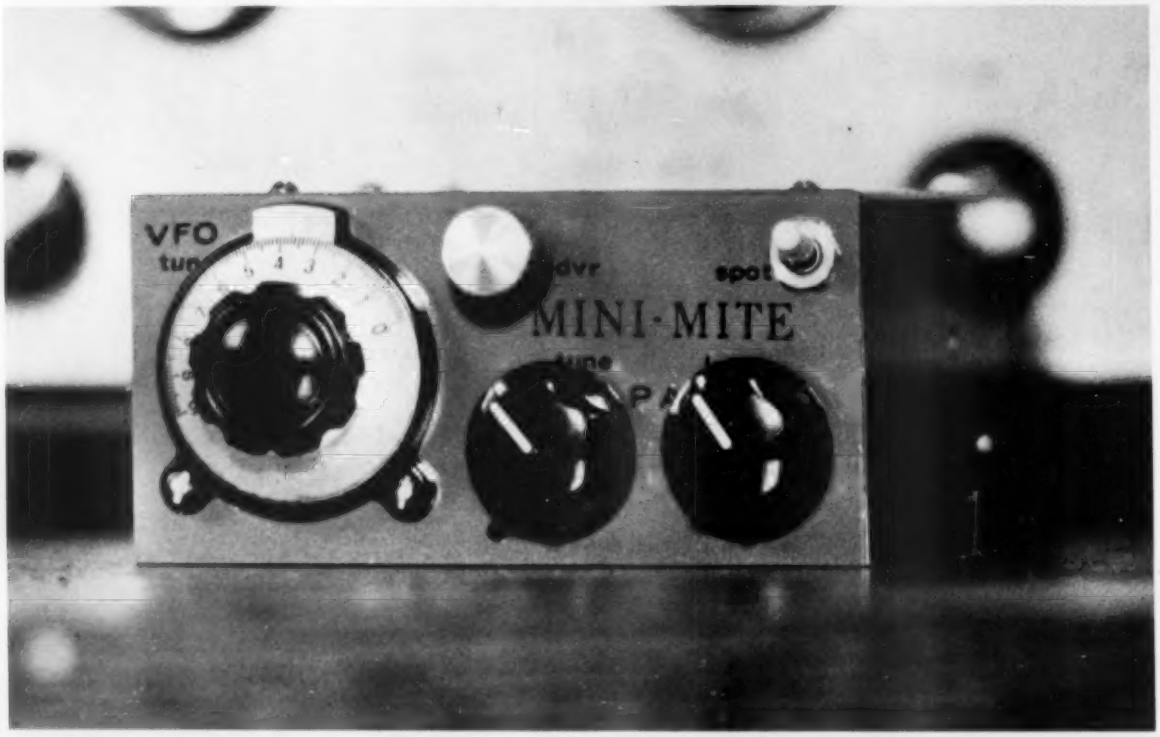
Operating QRP is fun. Operating portable is fun But, operating QRP with the kind of inefficient antenna systems sometimes encountered in portable operation is no fun at all. Sure, with a good matchbox, you can load a barbwire fence, or a set of bedsprings, but those aren't the best radiators in the world, and the puny little 100 mW QRP rigs will have a hard time getting across the street. While facing this dilemma, I decided someone should invent the perfect QRP rig, one that is small enough to be super-portable, low powered enough to run off a lantern battery, and gutsy enough to make some noise across town into the



The Mini-Mite, a "kilowatt" among QRP rigs, runs 7 Watts peak power for cutting through the QRM and clearing the frequency for the little QRP rigs.

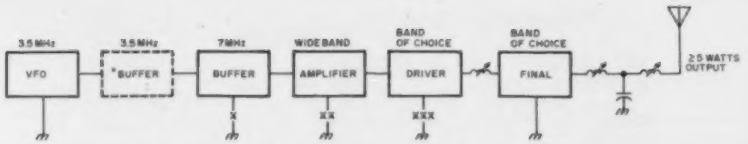


*Fig. 1. Block Diagram. The Driver and Final stage tuned circuits are selected for the band of your choice. Note they operate straight through on all bands for maximum efficiency. *This buffer is optional; it may be added to reduce vfo pulling – this is especially helpful when the unit is used with break-in keying. The keying points (shown by "X") have various advantages and disadvantages. See the text for a complete discussion.*

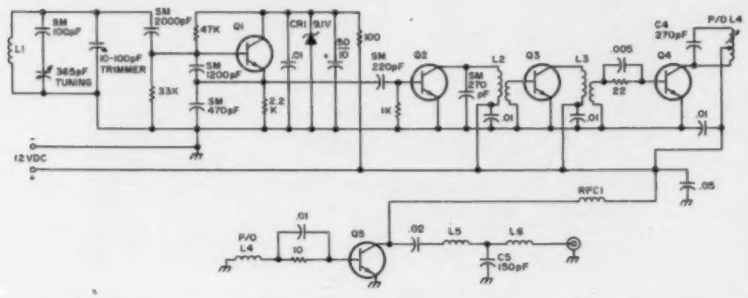


Fig. 2. Schematic Diagram. Coils are discussed in the text. All values in pF unlesss otherwise stated. Resistors are given in Ohms and are all ½ Watt carbon types.

average portable antenna.

Since I am the only inventor I know, I had to call upon myself to come up with this "wonder-rig." And (if I do say so myself) I did a pretty good job. The final outgrowth of the requirements is a muscle-powered mini-watter I call the "Mini-Mite." Now you can build yourself a Mini-Mite for less than twenty dollars. It is the perfect Novice rig with its 7 Watts dc input; it is the perfect standby rig for the oldtimers; and darned if it's not the answer to the QRP nut's portable operating dreams. The rig is vfo controlled (why be old-fashioned?), it runs a solid five Watts, can be held in one hand, and has a complement of controls you would expect to find only on more expensive rigs. You can build it for any or all the bands of your choice, 80-10 meters. And, finally, if you insist on staying around the one Watt level with your QRPing, you can leave out the final for a dandy low-power "low power" transmitter.

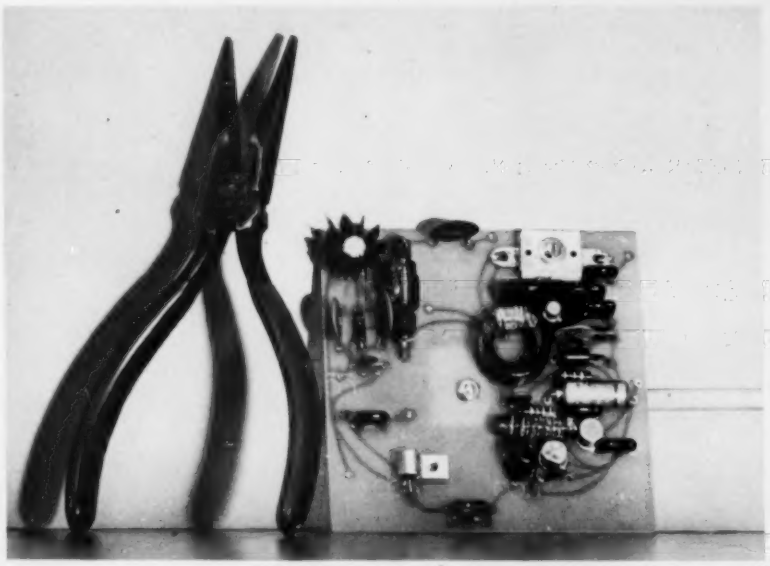
Fig. 1 is a block diagram of the Mini-Mite. The rig is pretty straightforward as far as using conventional circuits. Once you are into the schematic you will see some unique features that save space and money in the rig. The vfo circuit is very stable and you have a choice as to using a bipolar vfo or an FET vfo (schematics for both are given). The buffer shown in dotted lines is optional; it provides greater immunity to pulling as the rig is tuned and keyed. This option is a must for the operator who wants "everything" in his rig, or who is interested in using break-in operation. The buffer stage (solid lines) uses a broad-tuned low Q circuit which resonates at 7 MHz, but passes sufficient 80 meter signal to allow the rig to operate multi-band. The buffer operates class A and runs at fairly low power. The amplifier stage is a wideband outfit which delivers the first real power in the rig; you could use the amplifier output as a transmitter output, except that it is rich in harmonics. The driver serves two purposes; one, of course, is to provide power drive for the final. The other use for the driver is to select the harmonic of the vfo signal that will be used to transmit. The driver tuned circuit is comparatively medium Q. The driver tuned circuit alone does not provide adequate harmonic attenuation, so if you decide to build the "QRP" Mini-Mite you may leave out the final stage, but you must keep the final tuned circuit because it provides the necessary harmonic rejection. For normal QRP "plus" operation the driver feeds the final which in turn generates the so-called high-power output signal. The final output circuit is one of those unique circuits I mentioned, it uses slug-tuned forms to provide the tune and load controls. The output will easily load into 50-70 Ohms and a little more. Harmonic output at the final is very low and when the rig is properly tuned the output signal is very clean.

Fig. 2 is the schematic of the complete Mini-Mite. Some of the interesting features are the coils. You may pillage the junkbox to see what you have, or you may buy three sets of the units given in the parts list. For the vfo coil, L1, the buffer coil L2, and the rather unique output transformer L3, you use only the slug from a coil. You do not use the coil form itself. Coils L4, L5 and L6 use the complete slug-tuned form as these three coils are tuneable and must have some means of adjustment.

Construction

I am the biggest booster of perfboard construction when only one of anything is built, although the photos show a printed circuit board for building more than one of the units. The coils are available from Radio Shack and are sold two to a package at slightly over a buck.

The vfo in the pictures uses an Amidon T92 toroidal coil, but other units have been



Here is the Mini-Mite PC board.

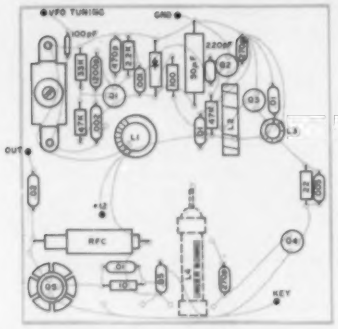


Fig. 3. PC board layout, top and bottom views.

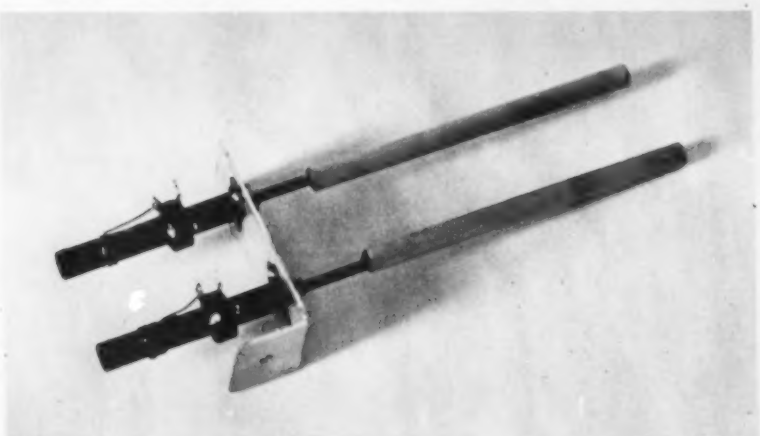
built using the slug as described and they offered comparable performance. Although you could construct the vfo in a separate shielded box, it is provided for right on the PC board. Fig. 4 gives the schematic for the alternate FET vfo. Both vfos tune with a 365 pF tuning capacitor and use a 100 pF fixed capacitor in series to limit the tuning range. Vfo tuning is linear for the bottom 100-200 kHz of the band and then becomes non-linear (but usable) over the remaining portion. This is generally acceptable, since most people will just put the linear portion in their favorite part of the band anyway. The FET vfo will provide more stability than the bipolar unit, but it will run the cost of the rig up a little since the same transistor that is used in the vfo can also be used as the buffer, amplifier and driver stage. Also, you may get slightly less drive to the buffer using the FET.

The buffer stage provides a compromise between actually isolating the oscillator and giving a little power output. That's why there is an alternate buffer, to provide isolation and little or no gain. Fig. 5 shows the alternate buffer; the circuit uses no tuned circuits and is merely stolen from the Radio Amateur's Handbook. The Mini-Mite buffer is straightforward and uses the slug form previously described (and as can be seen in the photos). It should resonate around 7 MHz if you want to check your work with a grid dip meter. The windings are wide-spaced along the entire slug, not wound closely together. Hold the windings in place with a little Q dope, or equivalent. The output link is wound on the cold end (Vcc side) of the coil and provides impedance matching for the amplifier stage.

The amplifier runs class B and there are no biasing resistors to worry about. It is very simple: The input goes on the base, the emitter is grounded, and the collector gets +12 through the output transformer L3. L3 is left untuned and serves to couple wide-band, harmonic loaded output to the driver stage. The transformer itself is a twist on the toroid. It is fabricated from a high-permeability coil slug that has a hole all the way through it. Either grab one from the junk box, or drill a hole (lengthwise) the rest of the way through the Radio Shack slug after the tuning screw is removed. This stage provides enough power to dimly light a #47 bulb connected across the secondary. The power is to put some kick in the driver stage and if not for all the harmonics, you could use this output for a QRP transmitter all by itself.

Harmonics are taken care of in the driver to a great extent. The higher power drive from the amplifier is used to drive the driver into class C for most efficient operation. When the driver operates, current flows through the 22 Ohm resistor, setting up a reverse bias that causes the stage to operate class C. The resistor is bypassed for the ac signal. The tuned circuit in the driver is close to that in the buffer, except that the coil is tapped to yield a higher Q with the higher power output. Harmonics at this stage are nothing like at the amplifier stage, but to use this stage as the QRP rig, you will have to couple the output tank circuit to get an acceptable signal. The tuning of the driver coil is accomplished by a wooden dowel shaft extension. The dowel should be approximately 4½ inches long to reach the front panel from its position under the PC board. As can be seen in the photos, the coil mounts on the PC board directly. An angle bracket is satisfactory mounting.

The final stage will run a theoretical 7 Watts dc input. The output circuit is a "T" network with slug-tuned coils used as the output tuning and loading controls. The final output transistor is rather expensive, but is hardy and generally works well in



Here is the final tune-load assembly. The angle bracket is mounted to the inside of the cabinet and the wooden dowels serve as tuning shafts to the front panel.

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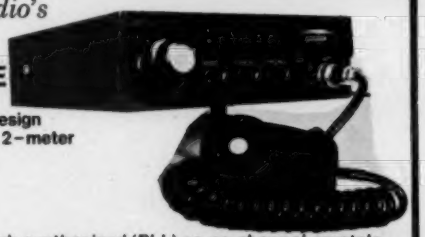

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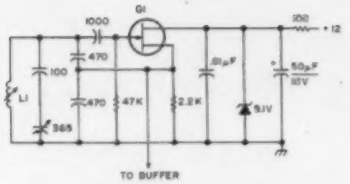


Fig. 4. Alternate FET vfo. Capacitors and resistors in pF and Ohms unless otherwise stated.

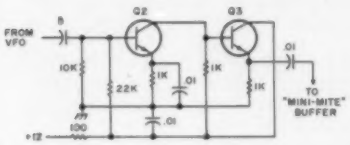


Fig. 5. The optional buffer is used in conjunction with buffer in transmitter to provide better isolation for break-in operation or for when some pulling of the vfo cannot be tolerated.

these applications. It will operate at frequencies in excess of the 30 MHz encountered in the 10 meter version of the Mini-Mite, so it is a pretty good choice until research proves the existence of a better all-around transistor. The rf choke used in the final is a high-current jobby. A conventional rfc has too much dc resistance and limits the output power stage can run. Wind forty turns #18 en. close and in 2½ layers directly on one of those slugs.

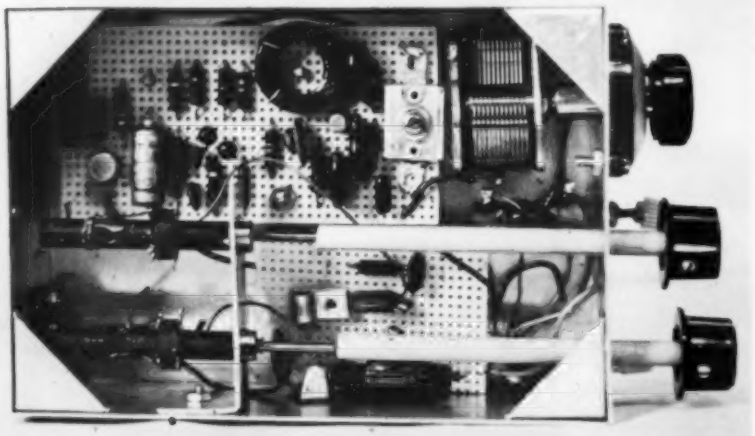
Table 1 gives values for coils and capacitors to be used for multi-band operation. You may wish to switch in the coil/capacitor combinations, or do some experimenting with winding multiple coils on the same form. Some of the problems are that the coil/capacitor combinations are sympathetic to harmonics and you may get false loading. But, as long as the Q is high enough, you could make each band peak at some different setting of the slug in the coil form. This helps eliminate the problem. Also, remember to use shielded solenoid inductance formulas because the overlapping coils act as shields and change the normal calculations. The cost savings of this system would be significant. This could be our answer to the old familiar tapped coil setups in tube-type rigs.

The final tuning coils are mounted on a piece of angle aluminum as shown in the photos. Each slug-tuned coil has a wooden dowel extension approximately 3-3/4 inches long. The dowels used on all the tuning setups are standard 1/4 inch diameter units. They are epoxied to the tuning screws. When the coils are tuned to minimum inductance, the knobs stick out from the front panel a little way. You can build the unit, tune it, then cut off the dowels at the right approximate length to keep the knobs from sticking out too far.

Coil /Cap	Band 80	40	20	15	10
L1	16t#28E (13t on toroid)	X	X	X	X
L2	X	8t#28E widespaced 5t link	X	X	X
L3	7t#28E 3t link	Same	Same	Same	Same
L4	30t#28E 10t link	15t#28E 5t link	8t#28E 4t link	5t#28E 3t link	4t#18E 2t link
C4	470 pF	270 pF	150pF	100 pF	68 pF
L5	25t#28E	13t#28E	7t#28E	4t#28E	3t#18E
C5	300 pF	150 pF	75 pF	50 pF	37 pF
L6	35t#28E	21t#28E	10t#28E	7t#28E	5t#18E

Table 1. Coil/capacitor data (final values will need trimming).

Construction is not too critical. The Mini-Mite is built in a 6x4x2 inch chassis (LMB #642); you may add the bottom plate which is available for this chassis. The circuit board is a very tight fit in the box. In order to get the circuit board in, it will have to be slid into place before the tuning capacitor is mounted. Then push the circuit board back all the way against the back wall of the box. This should leave enough room to insert the tuning capacitor. Hold the capacitor in place by means of its mounting holes and screws, then slide the PC board forward into its mounting place. The PC board is held away from the chassis on 1/4 inch spacers. Mount the spacers in place, tighten nuts over the mounting screws, and then the PC board is slipped into position and more nuts are placed over the mounting screws. This allows you to remove the PC board without the hassle of always fumbling to find a way to hold the spacers in place while you stick the mounting screws through them and the PC board.



The original bread board view of the Mini-Mite (note the final is missing in this photo) just goes to show that layout is not critical, as this unit worked quite well. Also this prototype used the optional buffer – the two plastic-type transistors just behind the vfo.

Operation

Before you can begin to operate the Mini-Mite, you must provide for the type of keying scheme which will best serve you. For instance, you may wish to key the oscillator for break-in. Fig. 1 suggests some keying schemes. The PC board is set up for keying the driver and final simultaneously. To change from this requires some revision of the printed tracks. Keying the driver and final is convenient and easiest, but has one major disadvantage. Dirty key contacts will increase the chance that some voltage will be dropped across the closed contacts. At the higher current levels encountered at this

point, you can drop, say, a volt or so, and lose effective input power to the final and driver, and degrade the output signal. Keep the key contacts reasonably clean and you should have no particular problems. Tuning up the Mini-Mite is pretty much like tuning any other rig, except that you must also tune a solid state rig for cleanest output signal. You will have to monitor on a receiver as you tune up. You can use a #47 dummy load, but take care not to leave the key down for periods over a minute or so, as the overvoltage to the bulb will burn it out. Tuning to an antenna can be accomplished with a field strength meter, in-line wattmeter, swr bridge on forward power, or a tuning meter as shown in the schematic Fig. 6. Tune for maximum all the way around and you should get the cleanest signal.

Well, for just under twenty dollars, the Mini-Mite is going to make the Novice a fine first rig. Or it will serve the guy who operates portable for fun quite well because it has enough kick to cut through some of the QRM. It also makes a great standby rig for the day when that low band transceiver pops off the air and you would like to tell the guys in the group what happened without a long distance phone call. Usually, when guys are on frequency and looking for you anyway, they will hear a little peanut whistle QRP rig coming in, so you will be able to set 'em straight (if you can still remember the code). And if you're a General or Advanced who has only got a transceiver that won't go on CW, here's your gateway to 20 wpm! ■

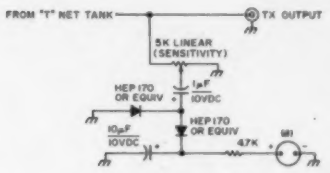
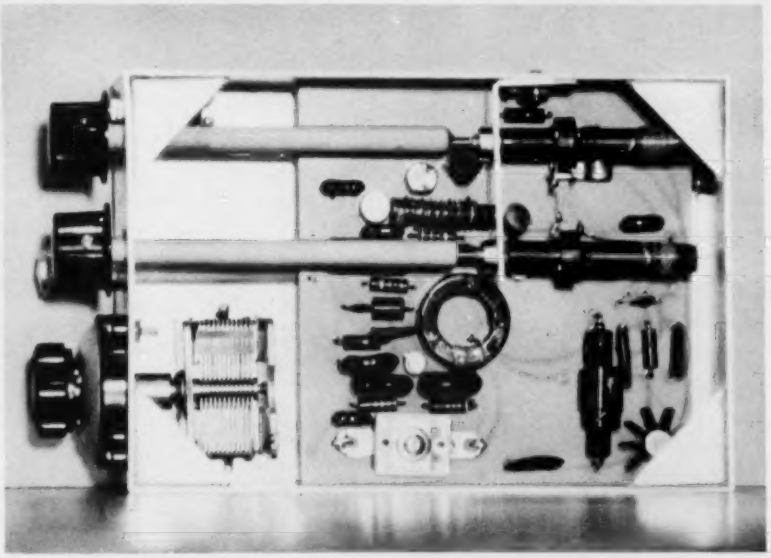


Fig. 6. Tuning meter. M1 is a tuning indicator or battery level indicator available from many mail order houses or the XYL's cassette player.



Here is the final version of the Mini-Mite component layout. The output transistor has a finned heat sink. The vfo is in the area shown with the toroidal coil although other coils may be used as discussed in the text.

Author's Note:

Add this modification (Fig. 7) to the Mini-Mite schematic. All it amounts to is adding a 100 Ohm resistor and a 1k resistor in the Buffer Amplifier. The 47k bias resistor is dropped so the stage runs class C.

The best way to run the rig as a 1 Watt output QRPer for anyone not interested in going the full 7 Watt route is shown in Fig. 8. Leave out the driver transistor and run a 100 pF between the output winding from the amp stage and the collector connection on the driver, then a 100 Ohm across the PA base to ground.

Parts List

Q1 2N709 or one of four Radio Shack 276-608
Q2 2N697 or one of above package
Q3 2N697 or one of above package
Q4 GE63 or one of same package
Q5 Motorola HEP53001
Coils (see text) Radio Shack 270-376
Tuning capacitor 365 pF Radio Shack 272-1344 or equiv.
Cabinet LMB 642 (6x4x2 aluminum)

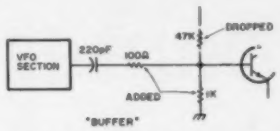


Fig. 7. Modification to the Mini-Mite.

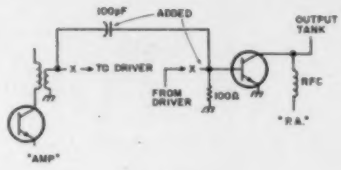


Fig. 8.

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A Fun Counter Project

--an invaluable test instrument

for under $50?

Al Plavcan
PO Box 6173
Anaheim CA 92806

My original goal in designing this counter was to produce an inexpensive, no frills, reasonably accurate, minimum parts design. I think I accomplished this for the most part. Read on and see if you agree.

High impedance FET input, .2 to 30 MHz frequency range, sensitivity ≤ 60 mV RMS across most of its range, and compact packaging are some of its features. Also, two modes of timebase operation are possible: xtal controlled with an accuracy of ±20 PPM ±1 count and line frequency (±.05%). The heart of the counter (less readout and power supply) is mounted on 2 PC boards (≅ 3" x 5"). The cost of the boards filled with parts (for line frequency operation) plus the 6 Minitron readouts will run you about $40. An additional $8 pays for the xtal controlled timebase, and of course you'll need a power supply. Any junk box parts substitute will naturally reduce your costs.

Operation

The block diagram of Fig. 1 shows the signal flow and control. Referring to Fig. 2, Q1 to Q4 shape the incoming signal to produce TTL compatible levels. A precise 100 ms gate (at IC19 pin 2) is then "or"ed together with the signal (IC19 pin 3). This gated signal is counted down and displayed on the readouts. The trailing edge of the 100 ms gate triggers the one shot IC24. A pulse is generated that strobes the quad latches IC7 to IC12. The stored data is transferred to

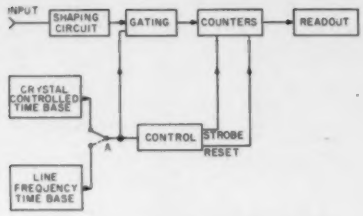


Fig. 1. Block diagram.

the decoders and readouts. The trailing edge of the one shot triggers another one shot IC25 to produce the reset pulse to counters IC13 to 18. All counters are reset to zero until the next gated input is counted. Thus the sequence is: gate, count, transfer, reset.

Construction

As mentioned earlier, the heart of the counter is mounted on 3" x 5" PC boards (actually 3" x 5-3/16"). You can package these boards any way you like. Just allow sufficient ventilation in any enclosure you use. One of the drawbacks of laying out small boards is that you can't get all the circuit connections on them that you'd like. So we're going to have to add some jumpers. Refer to Fig. 2 and Fig. 5. After all the components are mounted, jumper IC19 pin 2 to IC24 pin 3. Also jumper point "A" to the pad right above it (for line base operation). That's all the jumping we need for the Input and Control board.

The Readout board will require the following jumpers (refer to Fig. 3 and Fig. 6):

1. IC7 to 12 – jumper all pins 4 and 13 (strobe).
2. IC13 to 18 – jumper all pins 2 (reset).
3. IC13 to 18 – jumper pins 1 and 12 on each IC only.
4. IC13 pin 11 to IC14 pin 14.
5. IC14 pin 11 to IC15 pin 14.
6. IC15 pin 11 to IC16 pin 14.
7. IC16 pin 11 to IC17 pin 14.
8. IC17 pin 11 to IC18 pin 14.

Also, power to all ICs and all power grounds will have to be added. Refer to Fig. 3. Jumper grounds to the ground plane and between boards. I suggest you use Molex terminals to mount all ICs. The added cost is worth it.

The Input and Control board artwork (Fig. 5) is laid out for 60 Hz operation. If you're satisfied with an accuracy of approximately 500 PPM on your counter,

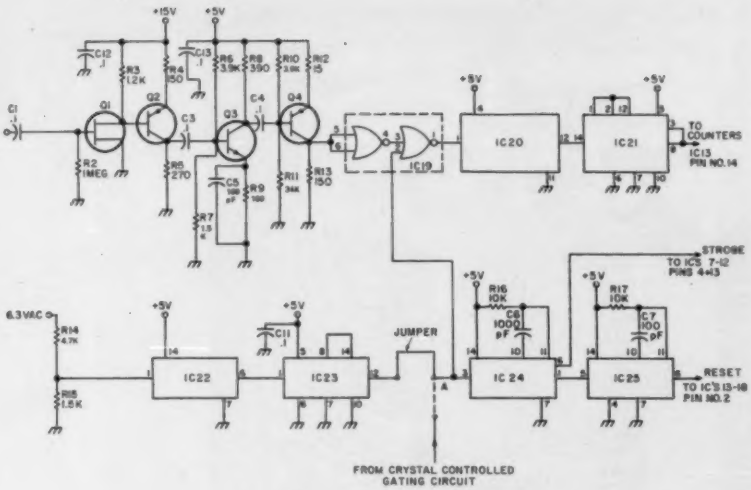


Fig. 2. Input and Control board.

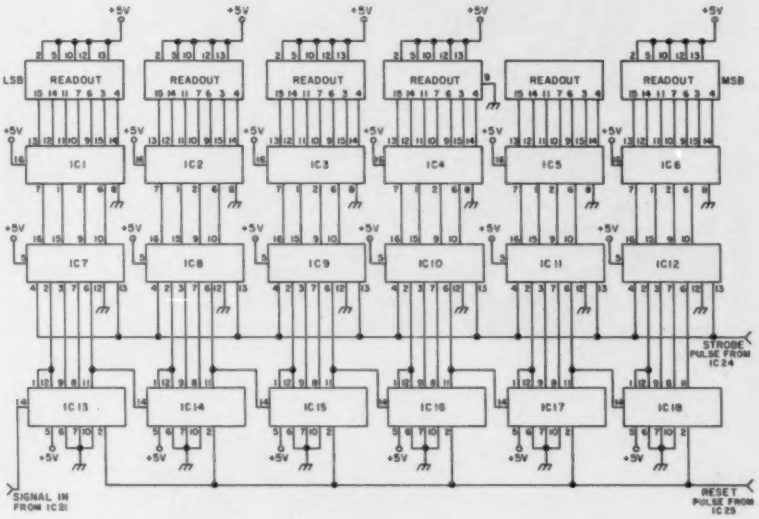


Fig. 3. Display board.

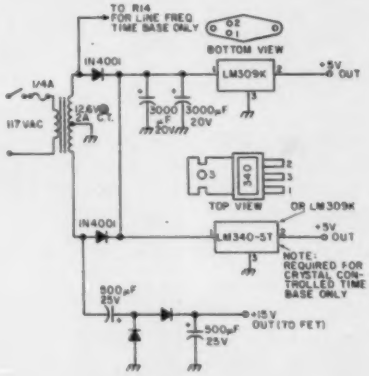


Fig. 4. Power supply.

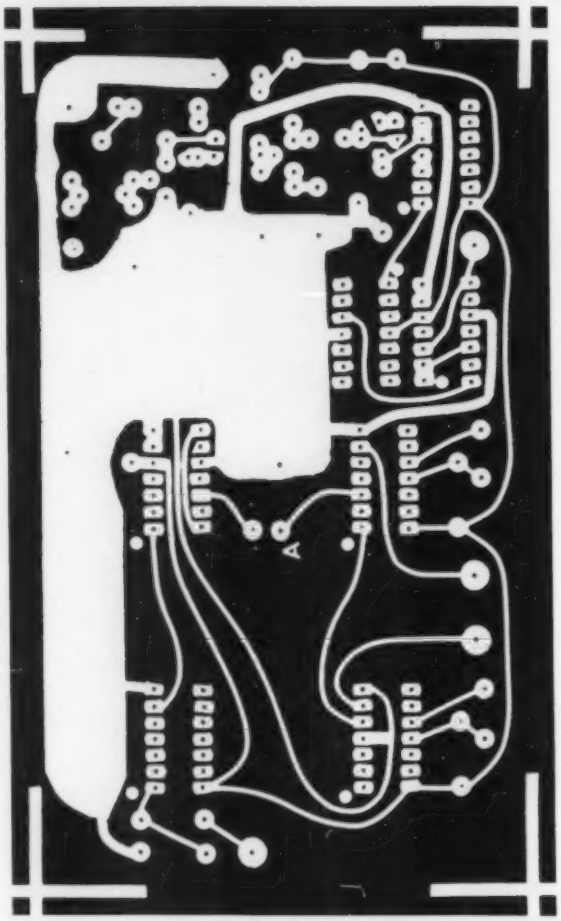


Fig. 5(a). Input and Control PC board, full size.

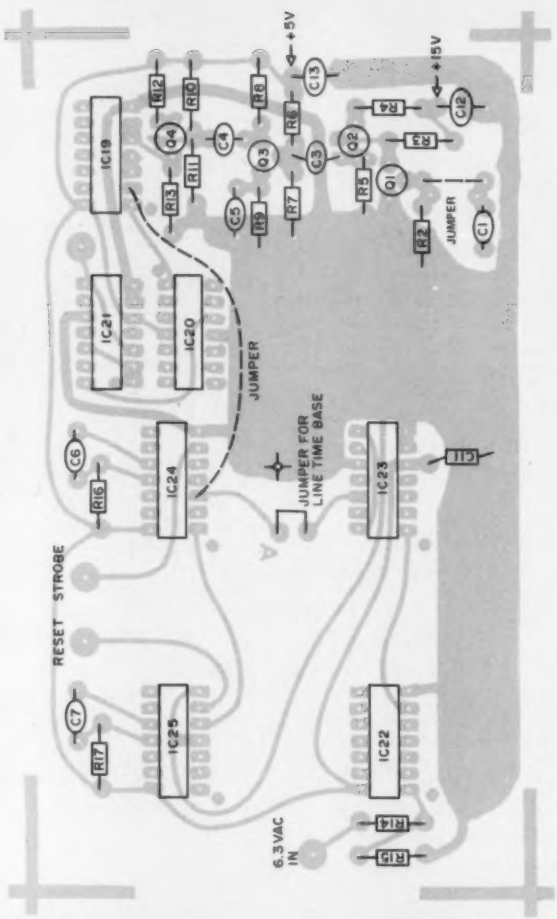
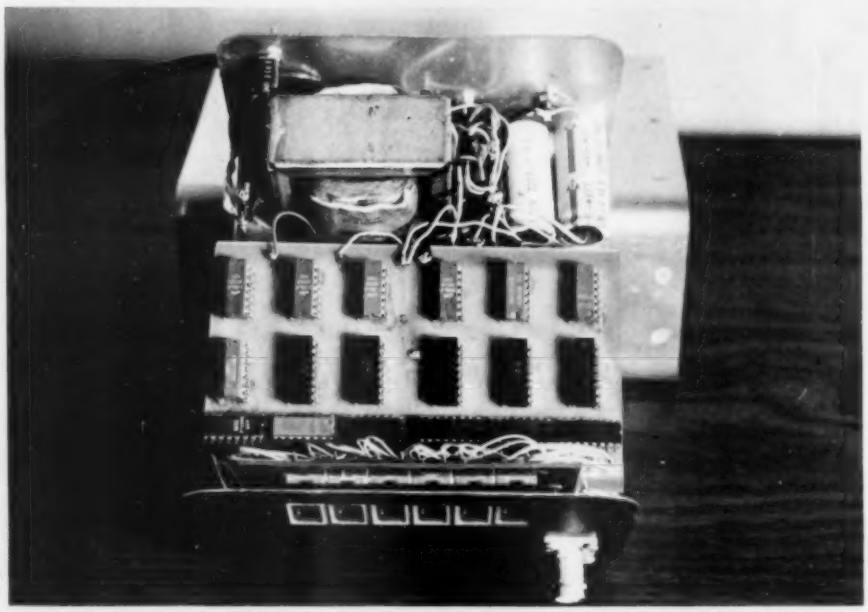


Fig. 5(b). Component layout, Input and Control board.

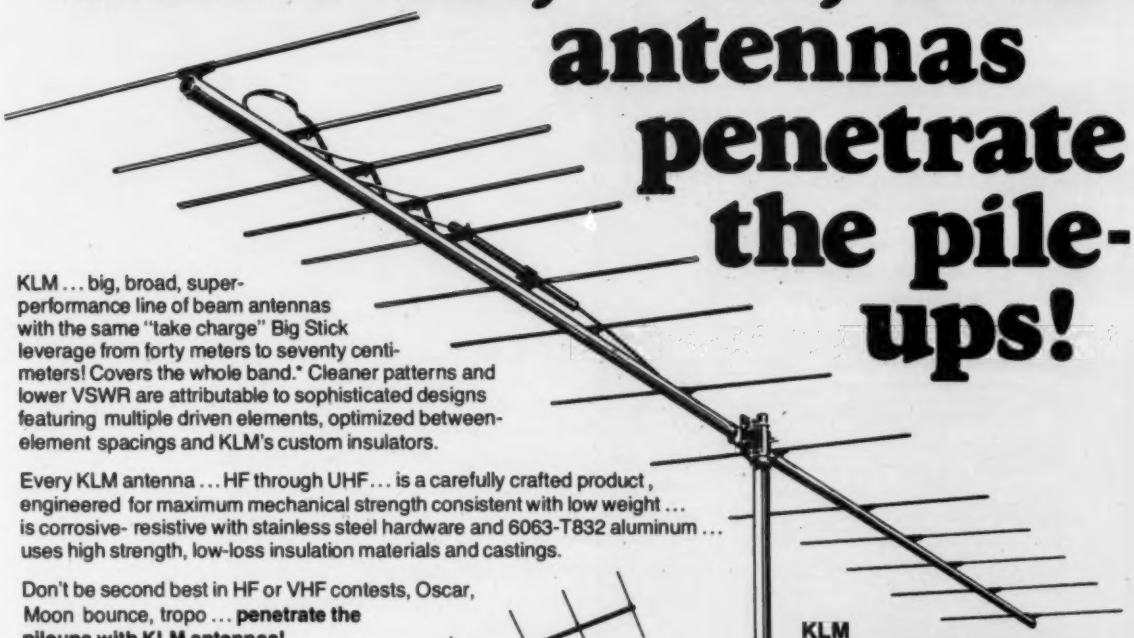
use it as is. You won't need the LM340-5T in the power supply, so that's an additional saving.

The crystal controlled timebase should be added to get the most accuracy from your counter. Fig. 7 is a suggested circuit. There is no artwork included for this additional circuitry. Layout is not critical and could be hand-wired in no time. If used, you won't need IC22 and IC23. To connect, remove the jumper at point "A" and connect the output on the last counter to point "A".

That's about it. If you got all the jumpers in right and your power is connected right (double check), you should be finished. The dot near each IC on the artwork is pin



KLM HF, VHF, UHF antennas penetrate the pile-ups!

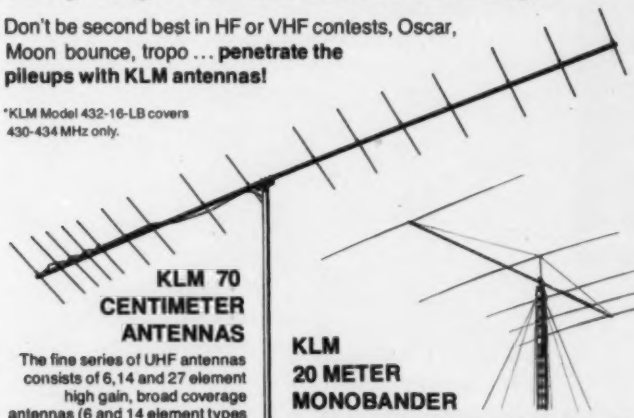


KLM ... big, broad, super-performance line of beam antennas with the same "take charge" Big Stick leverage from forty meters to seventy centimeters! Covers the whole band.* Cleaner patterns and lower VSWR are attributable to sophisticated designs featuring multiple driven elements, optimized between-element spacings and KLM's custom insulators.

Every KLM antenna ... HF through UHF... is a carefully crafted product, engineered for maximum mechanical strength consistent with low weight ... is corrosive- resistive with stainless steel hardware and 6063-T832 aluminum ... uses high strength, low-loss insulation materials and castings.

Don't be second best in HF or VHF contests, Oscar, Moon bounce, tropo ... **penetrate the pileups with KLM antennas!**

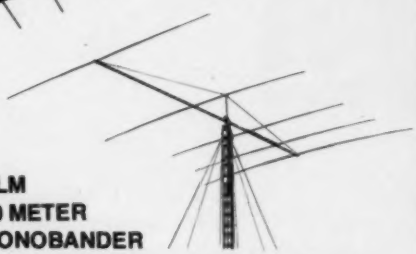
*KLM Model 432-16-LB covers 430-434 MHz only.



KLM 70 CENTIMETER ANTENNAS

The fine series of UHF antennas consists of 6,14 and 27 element high gain, broad coverage antennas (6 and 14 element types are rear mountable). **All antennas** (except the 432-16-LB) **cover 420-450 MHz without need for tuning.** These are ideal, maximum gain antennas for point-to-point or repeater control applications. An available **long boom** 12' model), optimized at 432 ±2MHz, is particularly desirable for EME and DX communications. Eight of these beams, using KLM high efficiency couplers are comparable to a 128 element, extended, expanded collinear array.

A typical antenna: (KLM-420-470-14)
Elements: 14.
Gain: 11.5db (dipole reference)
Beam width: 18 degrees @ 3db pts.
Diameters: Boom: 1" (25.4mm). Elements ⅜"D (9.5mm)



KLM 20 METER MONOBANDER

Do you operate both phone and CW and so are forced to compromise with higher VSWR on one or the other mode? **Not with this KLM 20 meter monobander!** Multiple driven elements and other KLM design exclusives, give broad-band action, low VSWR over 13.9 to 14.4MHz. F/B (and sides) ratio is excellent, gain is exceptionally high. (9.75 dipole reference). Impedance is 200 ohms balanced (matched w/KLM's 4:1 4KW p.e.p. balun (optionally available). Assembly is simple and fast.

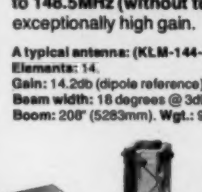
Other KLM beams for 40,15 and 10 meters feature dual driven elements for high gain, F/B ratio and low VSWR over both phone and CW band sections. **Also, a 7 element log periodic** w/26' turning radius, 30' boom (3", 76 mm) D **that gives continuous coverage, 10-30MHz!** Makes an excellent **NO TRAP**, 20-15-10 meter beam with gains equivalent to long boom, 3 element Yagi. Matches 50 ohm line w/4KW p.e.p. balun (supplied).

5 full size elements: Boom: 42', 3" (76mm)D. **Turning radius:** 28' **Wgt:** 65 lbs. (29.4KG)

KLM 2 METER ANTENNAS

The antennas in this series will beat all comers! Individually, these antennas are doing a tremendous job where high gain, F/B ratio and low VSWR are important ... in VHF DX contests for example. Many are stacking them for moon bounce and tropo work using available KLM baluns and couplers. Included in the series are antennas with 7, 8, 9, 11, 12, 14 and 16 elements, **all providing broad coverage. 143.5 to 148.5MHz (without tuning)** plus exceptionally high gain.

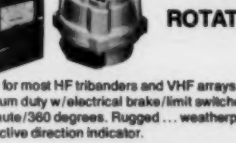
A typical antenna: (KLM-144-148-14)
Elements: 14.
Gain: 14.2db (dipole reference)
Beam width: 18 degrees @ 3db pts.
Boom: 208" (5283mm). **Wgt.:** 9 lbs (4 KG)



NEW AZIMUTH ROTATOR

Ideal for most HF tribanders and VHF arrays. Medium duty w/electrical brake/limit switches. 1 minute/360 degrees. Rugged ... weatherproof. Attractive direction indicator.

NEW ELEVATION ROTATOR



Use for OSCAR 6-7, Moonbounce, etc. Medium duty w/electrical brake/limit switches. 1 min./180 degrees. Rugged ... weatherproof. Attractive direction indicator.

At your dealers. Write for descriptive catalog.

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17025 Laurel Road, Morgan Hill CA 95037 (408) 226-1780, (408) 779-7363

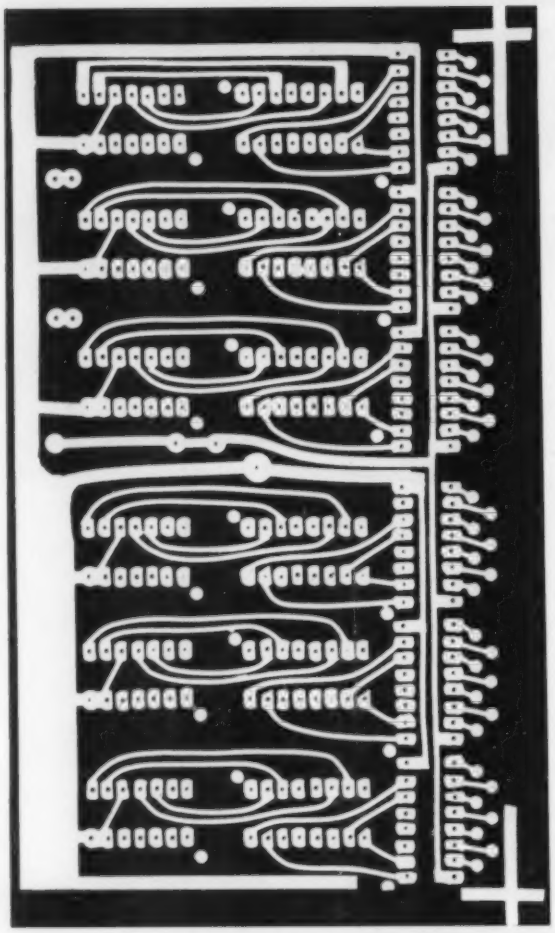


Fig. 6(a). Display PC board, full size.

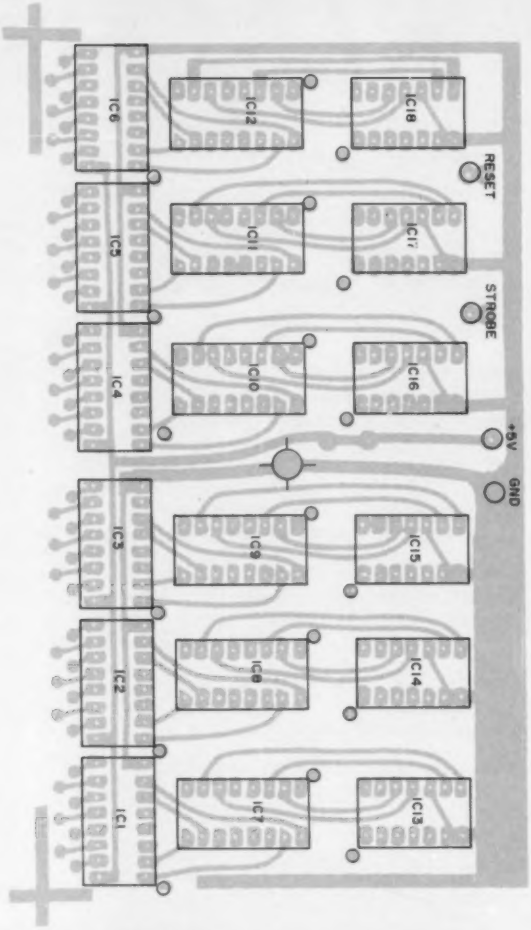
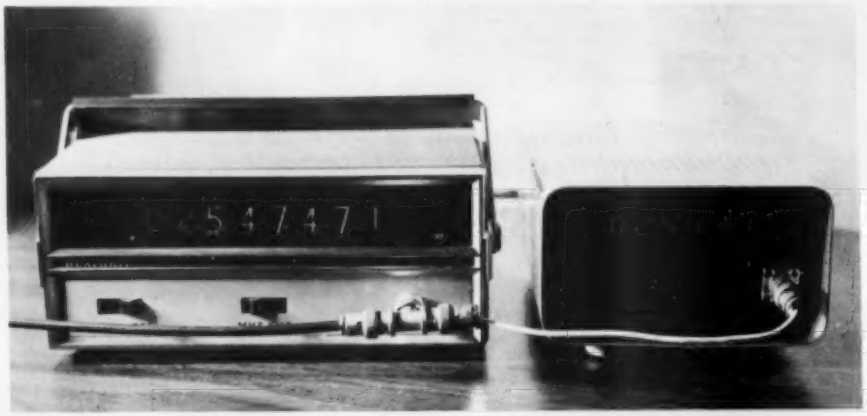


Fig. 6(b). Component layout, Display board.

1. Make sure all ICs are installed correctly. That's another reason for using the Molex terminals. It's a lot easier to reverse an incorrectly mounted IC with them.

There is no calibration procedure. If it's wired right, it'll work. One word of caution. If the counter fails to count all the way to 30 MHz, IC21 could be the cause. It has to divide by 5 up to 15 MHz. Substitute it with other 7490s until you get one that goes to 30 MHz on the input.

Finally, your counter is compatible with any of the prescalers available on the market, extending its range to 300 MHz. ■



Parts List

IC1 to IC6	7447
IC7 to IC12	7475
IC13 to IC18, IC21	7490
IC24, IC25	74121
IC22	7413
IC23	7492
IC19	7402
IC20	74S73
R16, R17	10k ¼ W
R2	1 meg
R3	1.2k
R4, R13	150
R5	270
R6	3.9k
R7	1.5k
R8	390
R9	100
R10	3.9k
R11	24k

R12	15
R14	4.7k
R15	1.5k
C1, C3, C4, C11	.1 mF 20 V
C5	100 pF
C6	.001 mF 20 V
C7	100 pF
Q1	MPF 102
Q2, Q4	2N3638A
Q3	2N2222
Q5, Q6	2N2222

IC terminals Molex Soldercon Series 90 Minitron Display (6)

Note: Transistors, ICs, terminals and display are available from Digi-Key Corp., P.O. Box 126, Thief River Falls MN 56701.

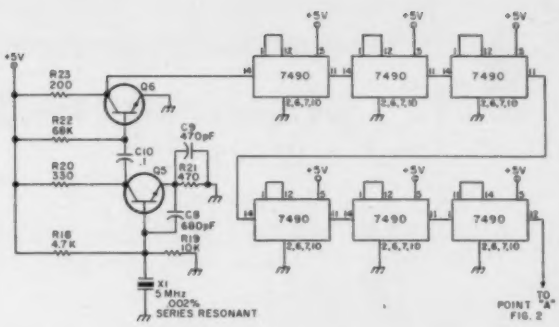


Fig. 7. Crystal controlled timebase.

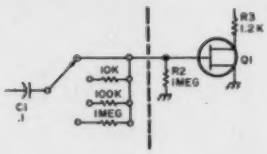


Fig. 8.

Note: For a more versatile counter, and to prevent overloading the front end, the input circuitry shown in Fig. 8 should be added.

NEW PRODUCTS

ICOM's IC-202

What has two meters, three Watts, and a swinging VXO wrapped up in a $280 package? The IC-202, of course!

A few months ago, Jay W6BWB, took his Japanese-born wife Kiyo to visit relatives in Japan. A trip to Akihabara, Tokyo's Electronics District, was also on the agenda. It was a fortunate bit of timing that ICOM had just introduced six meter and two meter walkie-talkies in Japan since Jay was "hot to trot" to get on two meter sideband after monitoring the activity for some months. It was also fortunate because the price was very reasonable when compared to other units available.

So he bought the rigs (for six and two). Listening on six or two in Tokyo was an eye-opener. I suppose it was because of their code-free license (held by many very technically competent engineers, by the way), but the bands were filled with activity day and night. Even from 60 miles outside of Tokyo, Jay found high activity.

Back in the states, the rig proved quite adequate for local QSOs out to 60 miles or so. The surprise came when he was able to work Los Angeles and San Diego some 320 and 420 miles down the mountainous coast of California! Jay's QTH is one of the better ones in Santa Cruz, but even with his KLM 16 element beam and 70 foot tower his total height above sea level is less than 125 feet. No matter how you slice it, 420 miles on 3.2 W PEP is nothing to sneeze at!

I've been able to check out two IC-202's at SBE's engineering facility. Both showed good results. Both had less than 0.125 uV sensitivity for 10 dB S+N/N ratio. Both gave better than 70 dB intermodulation rejection (+10 and +20 kHz signals required to equal the level of the desired signal). The AGC is reasonable . . . 15 dB audio change for over 70 dB rf change (0.3 uV-1,000 uV). Audio output is adequate for a portable package but may be marginal in noisy vehicles in mobile service . . . about 1 W.

The transmitter shows good design with spurious and harmonic content below the 70 dB range of the Spectrum Analyzer. Distortion products at the 3.2 W level allowed by the ALC are better than 30 dB below each tone (-36 dB by ARRL standards). Some have been able to increase the output to over 4 W PEP by backing off the ALC, but the 1.5 dB gained by doing this is probably not worth the 5-6 dB of additional "garbage" it causes.

The unit's size makes it a natural for trips, mountain-topping, battery operation, "natural power," and emergency use. It is roughly the size of the popular TR-22 FM transceiver (2¼ x 6½ x 7½). It features built-in batteries (nine "C" cells), internal whip antenna, external power jack, external antenna jack (SO-239), and external speaker jack.

The VXO covers two ranges as it comes from the factory, 144.00-144.20 and 144.20-144.40. Two additional ranges are available or an external VFO can be used. The VXO is calibrated in 5 & 10 kHz steps and can be set within about 1 kHz of a desired frequency. While this is not as accurate as rigs like the Echo II (which can be set within 100 Hz), it is good enough so that you can tell that a station is there.

The rig sports Receiver Incremental Tuning (RIT) so that the receiver can be tuned independently from the transmitter. The RIT has a center-off detent.

CW is accomplished by throwing a front panel switch each time CW is desired. This sets up a carrier shift of about 1 kHz for automatic offset. Some may find that the switch is inconvenient as it must be turned off again in order to receive. However, this is a minor inconvenience. CW output is about 4 W.

The "S" meter is of the "hang" variety making signal levels easy to read. Since it works off the AGC line it does not read below 0.5 uV, however, even though this is well into the "Q-5" area. The "S" meter doubles as an rf output indicator.

There is no squelch on the IC-202. While this is not considered a problem by many sideband operators, I like to have it on my rigs. I find it convenient.

Of the seven or eight IC-202 owners in the San Francisco Bay area, I don't know of any who have been disappointed with their units. Some have had some drift problems because of temperature variations in mobile service, but part of this seems to be traceable to using cheaper grades of American crystals not specifically cut for VXO service. ICOM has not published full specifications for the crystals and so far only includes 144.0-144.4 crystals. Since operations in many parts of the country center around 145.010 in keeping with the .010, .110 tradition on other VHF bands (6m, 2m, 220, 432, 1296), ICOM might do well to include the 145.0-145.2 MHz range at least as an option. This might eliminate the spec problem.

Speaking of frequencies, due to the very rapid growth of SSB in the San Francisco Bay area we have frequent QRM problems when QSOs get going in several communities independently. Since cross-town signals are quite loud, signals from other areas often aren't noticed. However, the poor guy located in between two such QSOs ends up with a real problem!

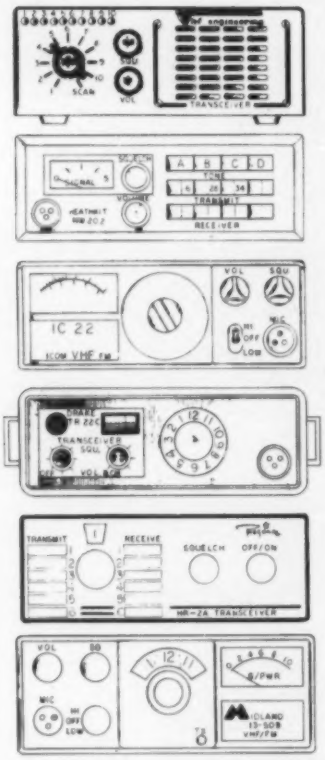
Perhaps a lesson from the 11 meter bunch would be in order. We've already made a gentlemen's agreement to use 145.005 for "DX" with 145.010 for monitoring and calling. Then "private" QSOs move up 20 or 30 kHz to get out of the way. CBers go one step further in that each community has its "channel" so that when they QSY off the calling channel they don't end up on distant QSOs. While something this formal might not be desired, it has the advantage that one can find someone in a specific area by calling on that frequency. I figure if "Red Rover" can handle it, hams ought to be able to do it!

One last comment. Bob WA6MUG took his 202 up to Lick Observatory on Mt. Hamilton (3500 feet). He worked many Bay area stations plus several hams down at Webster Radio in Fresno . . . some 120 miles. Signals were very good all the way around. The clincher is that Bob was using *battery power* and the *internal whip antenna!* The IC-202 promises to be a fun radio.

James Eagleson WB6JNN
Santa Cruz CA

vhf engineering
announces the
synthesizer II

If you have one of these fine rigs . . .
. . . or any transceiver whose transmit crystals are 6-8-12 MHz and receiver crystals are in 15 or 45 MHz range, and are tired of buying crystals, but you can't afford $400-$700 for a new synthesized rig . . .



VHF Engineering now gives you an inexpensive alternative with its versatile, unique "Synthesizer II."

The Synthesizer II is a two meter frequency synthesizer.
Frequency is adjustable in 5 KHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 KHz to 10 MHz. No additional components are necessary!

SPECIFICATIONS

- Frequency: 140.000 – 149.995 MHz
- Transmit offsets: Simplex, +600KHz, –600KHz
- Plus 3 additional field programmable offsets.
- Output: 3 volts to a 50^ load
- Input voltage: 11 – 18VDC at .900 amps
- Size: 8" long x 5½" wide x 2¼" high
  20.32CM x 13.97CM x 5.715CM
- Complete kit including all electronics, crystal, thumb wheel switch, cabinet, etc.

Kit only $169.95 **Wired and tested $239.95**

ORDER FORM

Item	Part No.	Description	Price	Extension

Name _____ Total _____
Address _____ Shipping _____
City _____ NYS Resident Sales Tax _____
State _____ Zip _____ Total Enclosed _____
Master Charge or BankAmericard No. _____
Bank No. _____ Expiration Date _____

TERMS: C.O.D., cash or check with order. We also accept BankAmericard and Master Charge.
CLAIMS: Notify VHF *and* the carrier of damage within seven (7) days of receipt of shipment.
RETURNS: Obtain authorization from VHF before returning *any* merchandise.
PRICES AND SPECIFICATIONS: Subject to change without notice.
SHIPPING INFORMATION: All shipments are F.O.B. Binghamton, N.Y. 13902. Shipments will be made by the most convenient method. Please include sufficient funds to cover shipping and handling. Allow 3 to 4 weeks for delivery.

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TX144B Kit . .	transmitter exciter – 1 watt – 2 meters	$ 29.95
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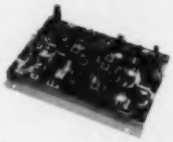
TX220B Kit . .	transmitter exciter – 1 watt – 220 MHz	29.95
TX220B W/T. .	same as above – factory wired and tested	49.95
TX432B Kit . .	transmitter exciter 432 MHz . . .	39.95
TX432B W/T. .	same as above – factory wired and tested	59.95

RX50C Kit . .	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit . .	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T. .	same as above – factory wired and tested	114.95
RX220C	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX432C Kit . .	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF.	accessory filter for above receiver kits gives 70DB adjacent channel rejection	8.50



HT144B Kit . .
2 meter – 2w – 4 channel – hand held xcvr with crystals for 146.52 simplex 129.95

PA2501H Kit .	2 meter power amp – kit 1w in – 25w out with solid state switching, case, connectors	59.95
PA2501H W/T.	same as above – factory wired and tested	74.95
PA4010H Kit .	2 meter power amp – 10w in – 40w out – relay switching	59.95
PA4010H W/T.	same as above – factory wired and tested	74.95
PA144/15 Kit .	2 meter power amp – 1w in – 15w out – less case, connectors and switching	39.95
PA144/25 Kit .	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit .	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit .	power amp – similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10 . . .	10w in – 140w out – 2 meter amp – factory wired and tested .	179.95
PA140/30 . . .	30w in – 140w out – 2 meter amp – factory wired and tested .	159.95

PS3 Kit.	12 volt – power supply regulator card	8.95
PS15C Kit . . .	NEW – 15 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T . .	same as above – factory wired and tested	94.95
PS25C Kit . . .	NEW – 25 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T . .	same as above – factory wired and tested	149.95

RPT144 Kit . .	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 Kit . .	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit . .	repeater – 10 watt – 432 MHz (less crystals)	515.95
RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching	$ 6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
COR2 Kit . . .	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX .	19.95
Crystals	we stock most repeater & simplex pairs from 146.0-147.0 (each)	5.00

Build a FAX from Scratch

-- repeater control, with ID

Most anyone who owns one will agree that finding a surplus facsimile machine was something of a mixed blessing. The unit is probably large and unwieldy; replacement parts are a problem; and some modification was likely to be needed before the recorder could be used. The alternative, customizing one's own FAX machine, isn't really too difficult. The recorder presented here requires no great amount of mechanical ability to construct. It is an electrolytic type. Chemically treated paper is drawn between a rotating helix (nichrome wire) and a steel blade. A potential between blade and helix causes a marking ion to be deposited on the paper. The unit will record FSK transmissions of weather maps, as well as some wire service photo transmissions, though the latter will suffer mirror image in recording -- pictures come out reversed with respect to left and right.

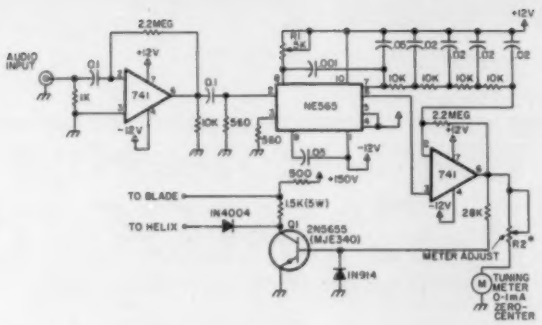


*Fig. 1. Demodulator. *Adjustable dropping resistor for zero-center milliammeter.*

73 Magazine has published a series of interesting articles on facsimile during the last several years: "An IC Facsimile Receiving Converter," Brockman, January, 1974; Ralph Taggart's series, "A Satellite FAX System You Can Build," August, September, and October, 1975; "A Fast Scan Facsimile System with SSTV Compatibility," Winkler, March, 1973; and "Facsimile for the Radio Amateur," Dean, August and September, 1971. I suggest that this material be explored before getting into the project. In particular, the article by Bob Dean (of Alden Electronic & Impulse Recording Equipment Co.) should be reviewed. It is an informative and comprehensive report on amateur facsimile.

There is one definite prerequisite before getting underway. A little Western Union Telefax transceiver will be needed for a source of gears and bearings (and some electronic components). These "deskfax" units are still plentiful on the surplus market. If there is any difficulty in finding one locally, I can supply a source ($5.00 for the unit plus shipping). Please include a self-addressed

Clyde B. Lee, Sr. W4NK
117 Woodmore Ave.
Louisville KY 40214

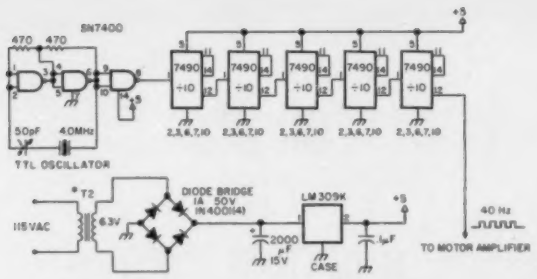


*Fig. 2. Precision ac source. *Filament transformer from deskfax.*

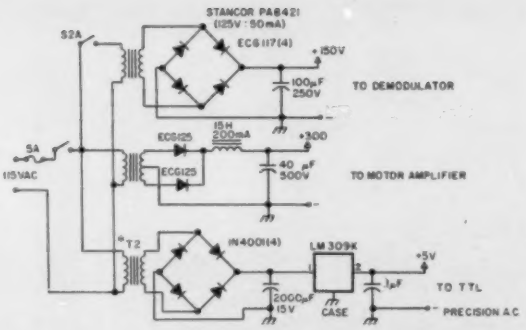


*Fig. 3. Power supplies. *T2 – 6.3 V from deskfax. S2 – DPST switch.*

stamped envelope with your request.

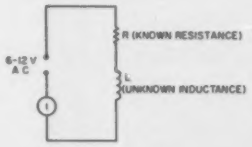
Electronics

The demodulator, Fig. 1, is merely a RTTY terminal unit. A suitable lead resistor and diode have been added to optimize it for facsimile. This circuit, employing an NE565 phase locked loop, was presented by Nat Stinnette W4AYV in the February, 1975, issue of *Ham Radio Magazine.*[1] The demodulator works on the FM principle. The voltage-controlled oscillator of the NE565 locks onto the incoming signal and tracks it between the frequencies of the black (1500 Hz) and white (2300 Hz) tones, resulting in a corresponding dc shift at the output. A voltage comparator connected to the output of the PLL produces plus and minus voltages to activate printing transistor Q1. A zero-center milliammeter functions as a tuning indicator.

The precision ac source Fig. 2, supplies 40 Hz to a 50 Watt class B motor amplifier, using a pair of 6550 tubes connected as zero-biased triodes. Inasmuch as the deskfax operated at 180 rpm (60 Hz supply), 40 Hz is required to lower the speed of the synchronous drive motor to produce 120 rpm. The 120 rpm helix rate is required to copy weather map and some wirephoto transmissions. The little TTL crystal oscillator circuit is a "surefire" one from *QST*, February, 1974, p. 34. When others are cranky, this one will work!

I used the following procedure to select T_X, the motor amplifier output transformer (see Fig. 3). The method requires a known composition resistor, VTVM, and filament transformer (part of a more extensive routine by WØMKF in *Ham Notebook* for determining values of unknown inductances). The setup will only give ball park values of impedance, but that's close enough:

1. Measure ac voltage across known series resistor.
2. Compute I from E/R_L.
3. Measure ac voltage across inductance.
4. Compute Z from E/I.

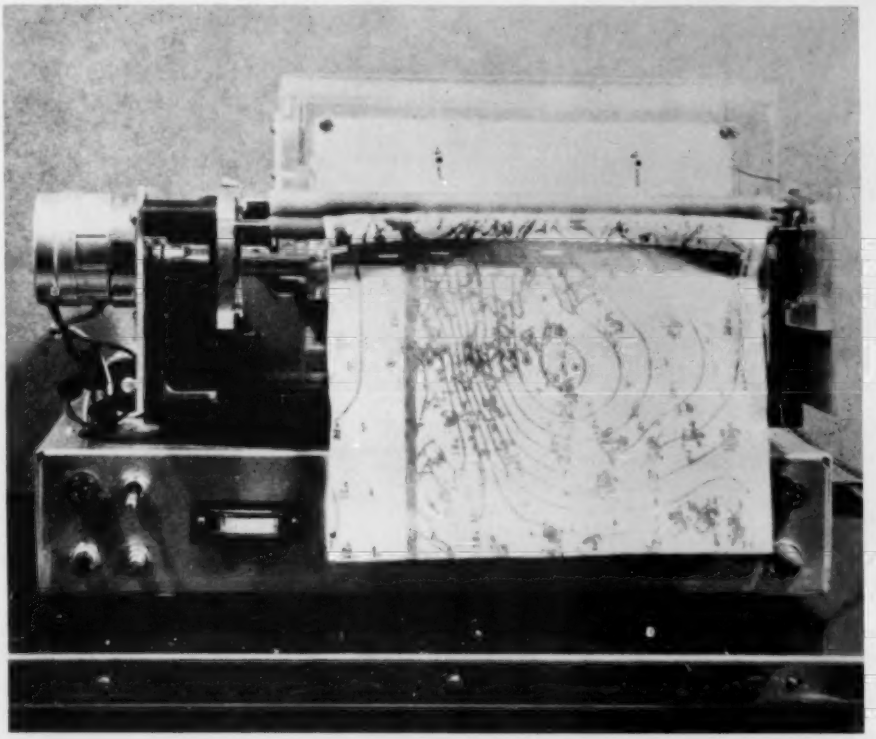


Applying the method, in turn, to deskfax motor windings, primary and secondary of a surplus (unmarked) power transformer on hand, the following values were obtained:

Deskfax: $\frac{Z\ (Ohms)}{750}$

Primary: 1400

Secondary: 20k



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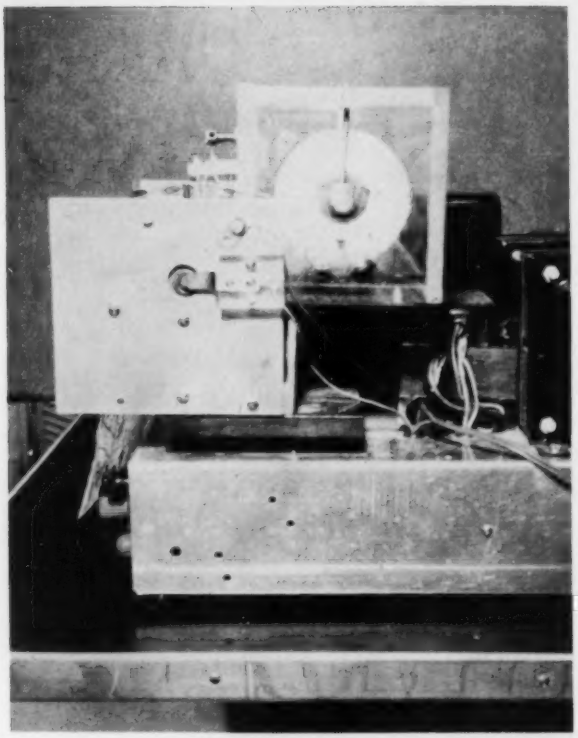
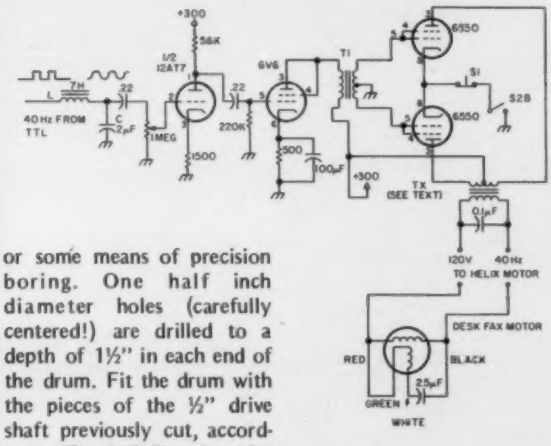


Helix contactor.

Fig. 4. Motor amplifier. T_X – see text. T1 – Stancor A4713. C – Stancor C1707. S1 – N.C. SPST push-button switch. All resistors ½ Watt 10%.



That's the best combination my junk box could produce – anyway, it works!

In the motor amplifier, Fig. 4, L and C (7 Henry choke and 2 mF capacitor) filter the square wave 40 Hz tone from the TTL source to an acceptable sine wave for the amplifier. In selecting the output transformer, T_X, select a husky one, 115 V primary, with a secondary around 350-0-350 V at 175 to 200 mA.

Mechanics

As a first step, dismantle the deskfax. Disengage the traversing mechanism. Rotate the drum and slide it slowly to the left. As you look through the hole in the drum you'll see a brass screw in the drive shaft. Remove the screw. Loosen the collars and fiber gear. Now the half inch drive shaft can be removed from the left. Remove the cradle and strip it. Remove the following electronic components: the push-button switch, the 6.3 V filament transformer, and the 2.5 mF motor capacitor.

Cut the cradle in two, making the cut 4-3/4" from the left end (the bronze sleeve bearings should be covered to protect them from filings). Next, cut the 1/2" steel drive shaft as follows: from the left end of the shaft, 1 piece 4-7/8"; from the right end of the shaft, measuring from the shoulder, 1 piece 2" long. (This allows ½" clearance between the end of the helix drum and the right bearing.) See Fig. 5. Center and drill and tap the bearing end of the 2" piece for a ¼" 4/40 screw (this will be a wiping contact).

Helix

I've used Wink W6WMI's system in constructing the helix. (See Fig. 5.) The helix drum is a plexiglas rod 1½" diameter, 10" long. This *is* a step that will require a lathe or some means of precision boring. One half inch diameter holes (carefully centered!) are drilled to a depth of 1½" in each end of the drum. Fit the drum with the pieces of the ½" drive shaft previously cut, according to Fig. 5. Drill and tap for a 4/40 screw ¼" in from the right end of the drum. This screw must go through the wall of the drum and make good electrical contact with the drive shaft. Drill and tap for 6/32, ¼" screws to anchor the #22 nichrome helix wire. The screws are located ¼" in from each end of the drum and positioned to form a 370° lead (one spiral turn occupying 9" with about 5° overlap at each end).

Looking at the right end of the drum, rotation will be counterclockwise. The nichrome wire is to be wound clockwise (sweep will be from right to left as contact is made with the blade). Snug the wire up as tightly as possible on the drum, then pass the free right end over to be fastened by the contacting screw.

Cradle

Using a 3/16" bit, drill any additional holes needed in the base of each of the two pieces of cradle previously cut. Set the pieces on a plexiglas sheet 3/8" by 4½" by 14¼". Temporarily install the helix and align it so that it turns smoothly. Mark the mounting holes, then drill and tap for #8 screws. A 13" by 17" by 3" chassis is used for assembling the recorder. Place the plexiglas base (above) on the chassis. At this time install whatever you intend to use for shock mounts. There should be at least 4. (Excellent shock mounts are available from the deskfax, but there are only 3.)

Paper Humidor

An aluminum plate 1/8" by 3½" by 10" is to be installed on the flange of the right cradle member (this flange formerly supported the optical system). Position the plate so that it overlaps the forward edge of the flange ½" and is aligned with the right end of the cradle. Before mounting the plate, using a 3/16" bit, drill holes in each corner of the plate for mounting the paper humidor.

The Alfax paper must be kept moist for the electrolytic process to work; so while the plexiglas enclosure does add to the expense of the project, it is an essential part of the recorder. IPS Weldon #3 solvent (or other suitable brand) is used in assembly. You'll need an applicator. I paid the additional price and had the distributor cut the pieces to size. See Fig. 6. The box goes together easily – just tack the members with a few pieces of Scotch tape, apply the sol-

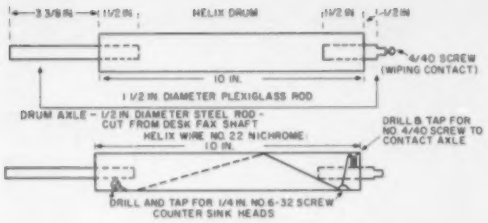

3 3/8 IN
1 1/2 IN
HELIX DRUM
1 1/2 IN
1 1/2 IN
4/40 SCREW (WIPING CONTACT)
10 IN.
1 1/2 IN DIAMETER PLEXIGLASS ROD
DRUM AXLE - 1/2 IN DIAMETER STEEL ROD - CUT FROM DESK FAX SHAFT
HELIX WIRE NO. 22 NICHROME
10 IN.
DRILL & TAP FOR NO. 4/40 SCREW TO CONTACT AXLE
DRILL AND TAP FOR 1/4 IN. NO. 6-32 SCREW COUNTER SINK HEADS

Fig. 5. Helix.

vent, and in a matter of seconds the pieces are *really* welded. Note that paper will be fed through a 1/8" slit, formed by pieces A and B of the front of the humidor.* Next cut out two supports for the Alfax paper. Use 3/8" plexiglas and cut to the dimensions of Fig. 6. Center these at the ends of the interior of the humidor and cement with solvent. Align the top, then drill and tap for a ½ inch 6/32 screw at each end. Place a roll of Alfax paper in the humidor and replace the top. Drill and tap for a 6/32 screw 2" long that will extend down through the cover and contact the hub of the paper roll. These should be about 9/16" in from the end of the cover and in line with the center of the hub. Do this for both ends. The 2" 6/32 screws installed will function as "brakes" to control the flow of paper.

Blade Assembly

Cut a piece of 3/8" plexiglas to 1¼ by 9½". Install steel pins at each end, as in Fig. 7. (Material for the pins can be taken from the deskfax push-button switch assembly.) Cut a piece of ½" aluminum angle and install with 4/40 screws as shown. The two screws at each end at the top will anchor two phosphor-bronze motor brush springs. The three screws along the forward edge will secure the blade,[2] wedging it between the plexiglas and the aluminum angle. (The National Weather Service and some TV stations use Alden facsimile recorders that use a blade in the form of a steel loop. These are discarded after a little wear and are a good source of material for the blade required here. 9½" sections can be cut from the loop.)

Paper Feed Assembly

See Figs. 8 and 9. The paper feed mechanism is driven by a 5 Watt, 115 V, ½ rpm, 60 Hz synchronous motor. This is a Hurst, Model CA, available directly from the Hurst Mfg. Co., Motor Division, Princeton, Indiana, currently at $18.06. This speed (½ rpm) with ½" rollers, produces a 9" by 11" recording. Not exactly symmetrical, if one is a purist. The rollers are made by slipping 10-3/4" lengths of rubber tubing (½" O.D., ¼" I.D.) over ¼" steel rod (the material should be turned and ground shaft or drill rod). The driven roller is 13-1/8" long; the idler is 11-7/8". Ball bearings (NICE type 1602 DC) are used for the driven roller. The bearings are 11/16" O.D., ¼" I.D. The tension springs, E and F, are 1-3/4" long, cut from the traversing mechanism (spring) of the deskfax. Reference Fig. 9: the 3/16" diameter holes at 0 and P are to be at a depth of 3/16" on the inner surfaces of supports A and D. These will retain a 3/16" rod (preferably brass) to smooth and align the paper as it emerges from the slit in the humidor. The bottom of the rod should align with the top of the helix and be positioned about 5/8" forward from the center line of the helix. (This detail is not shown in the exploded view of Fig. 8.) Two aluminum "end plates" of 1/8" material, each 4½" by 5¼", support the paper feed assembly and the contactor for the helix wire. See Fig. 10. A coupling 1" long will be required to couple the 3/16" motor shaft to the ¼" roller rod (you'll probably have to make this). Place the plexiglas supports, A and D, on their respective end plates, and align the top and forward edges. Mark the mounting holes and the center line of the driven roller shaft. Drill a 5/16" hole for the motor shaft. This is to be expanded to 1/2" after the motor mounting holes have been marked and drilled.

A 3/4" diameter hole is to be drilled in the right end plate, 1-3/4" from the top edge, 2-7/8" from the forward edge. This is for the rotating contact (a 4/40 screw) in the right end of the helix drive shaft. The contactor is merely a piece of "springy" brass mounted on a small piece of 3/8" plexiglas.

Getting It All Together

Install the fiber gear and then the 7/16" collar at the left end of the helix drive shaft. Install the helix drive motor in the left cradle member. Place the helix in the sleeve bearings and mount the assembly to the plexiglas base. Position the aluminum end plates with the bottom edges aligned with the bottom of the cradle, and with the rear edges aligned with the rear edge of motor support. Attach these to the ends of the cradle with #8 screws (2 in the lower edge and 1 on the uprights that house the sleeve bearings). Press the ball bearings into the 11/16" holes in the plexiglas supports (A and D). Slip the paper smoothing rod into each support, seating it at 0 and P (Fig. 9). Install the driven roller. Attach this assembly to the aluminum end plates. The left support, A, will require 3 spacers 1½" long. These can be made up of 3 sets of 3/8" O.D. spacers for #8 screws, ½" long (H. H. Smith #2119) and 1" long (H. H. Smith #2117). Slip the coupling onto the left end of the roller shaft; mount the motor. Mount the springs and adjustable bearings (Fig. 8) for the idler roller. Install the aluminum base plate for the paper humidor. Place the humidor on the plate, centered with the helix, and with its front 1-1/8" from the center line of the helix. Mark and attach the humidor to the plate (use ¼" screws). Slip the left pin of the blade

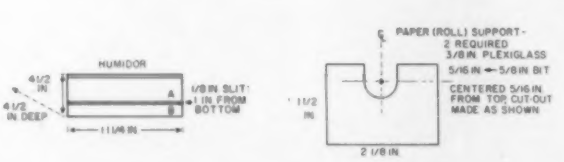


Fig. 6. Humidor and roll supports. Humidor (3/8" plexiglas): 2 pcs. 3-3/4" x 3-3/4" (ends); 1 pc. 4-1/8" x 11-1/4" (back); 1 pc. 3-3/4" x 11-1/4" (bottom); 1 pc. 4-1/2" x 11-1/4" (top); 1 pc. 2-5/8" x 11-1/4" (front); 1 pc. 1-3/8" x 11-1/4" (front). Assemble with IPS Weldon #3 solvent.

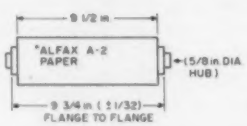


*Fig. 6(a). *Alfax paper collapsible core.*

*Plexiglas, solvent, and rubber tubing were obtained from General Rubber & Supply Co., 3118 Preston Highway, Louisville KY.

assembly into its mounting bracket (a piece of 1/8" brass, ½" by 3"). Rest the blade on the helix, center it, and, with the blade assembly leveled, mark the right end plate for a 1/8" bearing hole. Similarly mark and mount the left bracket. (Small thin pieces of brass, attached with 4/40 screws to the outer surfaces of the bearing members, will prevent lateral movement of the blade assembly.) Two #8 screws, 1¼" long, support the phosphor-bronze motor springs (Fig. 7). Use a #55 (or similar) bit and drill a hole adjacent to the head of each screw. Drill and tap the front wall of the humidor for these #8 screws, 1" from the top and 1¼" inch from each end. Two ¼" hex spacers, 1" long, threaded for a 6/32 screw (H. H. Smith #2324) are drilled and tapped for a 4/40 screw at ¼" from an end. Run a locking nut down on two 4/40 screws, 3/4" long, and then install in the hex spacers. Solder compression-type springs (I cut them from a transistor heat sink clip) to the tips of each 4/40 screw. Thread small gauge copper wire through the holes in the #8 screws after installing them in the front wall of the humidor. Secure the ends of the phosphor-bronze springs (the other end of the springs should be fastened to the aluminum angle of the blade assembly). Solder a lead to the right spring. Attach the helix contact to the right end plate, centering it on the 4/40 screw head from the drive shaft. Put a few drops of #10 oil on the sleeve bearings and worm gear. Turn the helix by hand to see that everything is still aligned. Set the collar and fiber gear in place. There should be just a tiny amount of backlash with the fiber gear and worm — and a similar "tiny" amount of end play between the collar and left bearing. Apply power to the helix drive motor to make any final adjustments of the 4 mounting screws necessary for smooth operation. Pour a small quantity of water into the humidor, and, assuming all of the electronics are functioning perfectly(!), place a roll of paper in the recorder and look for NSS!

Operation

Fleet facsimile broadcasts are made from NSS, Washington, D.C., on the following frequencies (kHz): 3357, 4975, 8080, 10865, 16410, and 20015. Incidentally, publication H.O. 118, available from the U.S. Naval Oceanographic Office, Washington, D.C., contains a wealth of data on worldwide FAX weather broadcasts (as well as RTTY). There is also information on interpreting weather codes.

This is the procedure I used with a Drake SSB receiver, an R4B, to adjust the PLL demodulator. Tune in the NSS signal (upper sideband). Most transmissions are of about 10 minutes duration, with 800 Hz shift between 1500 Hz (black) and 2300 Hz (white). Set R1 of the demodulator fully clockwise (maximum resistance). Tuning to the 2300 Hz tone

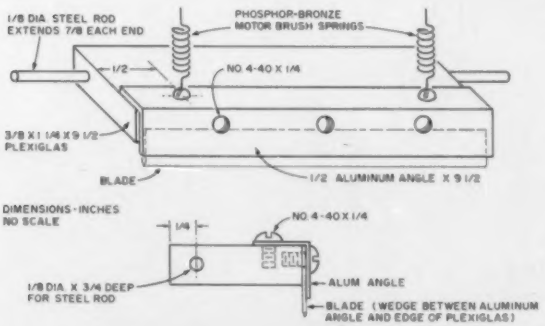
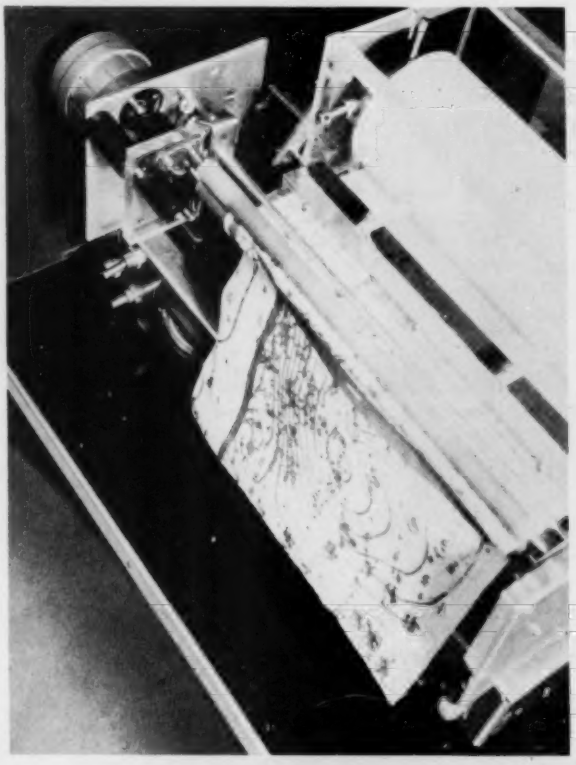

1/8 DIA. STEEL ROD EXTENDS 7/8 EACH END
PHOSPHOR-BRONZE MOTOR BRUSH SPRINGS
1/2
NO. 4-40 X 1/4
3/8 X 1 1/4 X 9 1/2 PLEXIGLAS
BLADE
1/2 ALUMINUM ANGLE X 9 1/2
DIMENSIONS - INCHES NO SCALE
NO. 4-40 X 1/4
1/8
1/8 DIA. X 3/4 DEEP FOR STEEL ROD
ALUM. ANGLE
BLADE (WEDGE BETWEEN ALUMINUM ANGLE AND EDGE OF PLEXIGLAS)

Fig. 7. Blade assembly.



Paper feed detail.

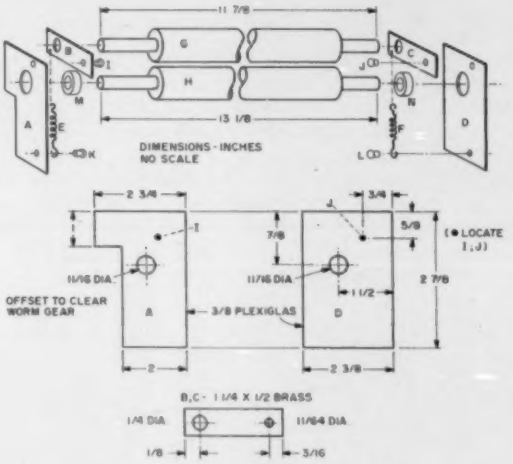


Fig. 8. Paper feed assembly (not to scale). A, D: left and right supports, 3/8" plexiglas. B, C: top roller bearing, adjustable brass, 1/8" x 1/2" x 1-1/4". E, F: tension springs. G, H: rollers. I, J: #8 screws, 1/4". K, L: 4/40 1/2". M, N: ball bearings.

should cause the zero-center milliammeter (tuning indicator) to deflect toward maximum negative. The 2300 Hz tone is transmitted between maps, so this is a good time to check the tuning indicator and set it for maximum deflection. Remain tuned to the 2300 Hz tone until a start tone is heard, indicating the beginning of the next map transmission. This will be a lower tone (I believe it is 675 Hz). This will be transmitted for 10 seconds, and will be followed by about 30 seconds of phasing pulses. During this time, with the recorder running, you should see the recording coming in as a field of black with a white line (about ½" wide) in the field. Momentarily activate the phasing switch (push-button) and note the shift of the white line to the right. Continue to pulse the phasing switch until you have the white line at the left edge of the paper. You now have your drum phased with that of NSS for proper reception of the map. The copy will probably look thin and skimpy with this setting of R1. Back off on R1 slightly and retune the signal. Note that you are able to control the width of lines in the recording (to some degree) by the setting of R1.

The recorder will copy wirephoto transmissions made at 120 rpm. Wirephoto transmissions will be on lower sideband (and inasmuch as press frequencies are private, it would be inappropriate to publish them here). I can say that occasionally I've tuned above 15690 kHz and come upon a signal that sounds like a flock of nervous wild turkeys, and with a little jockeying around the lower sideband, was able to get a picture.

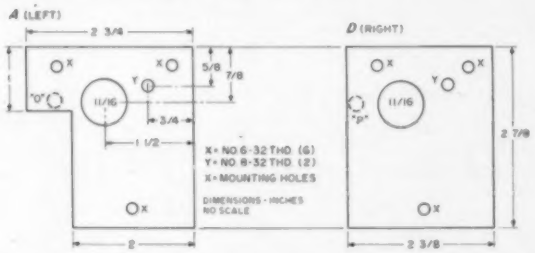


Fig. 9. Paper feed supports (3/8" plexiglas). Drill and tap each piece for 8/32 ¼" screw, 3/4" from forward edge, 5/8" from top. Drill 11/16" hole for ball bearing, on each piece 1½" from forward edge, 7/8" from top. O and P: 3/16" diameter holes to a depth of 3/16" on inner *surface of each piece, 7/8" from top, 2¼" from forward edge, to retain 3/16" smoothing and aligning rod (brass, 3/16" x 12¼").*

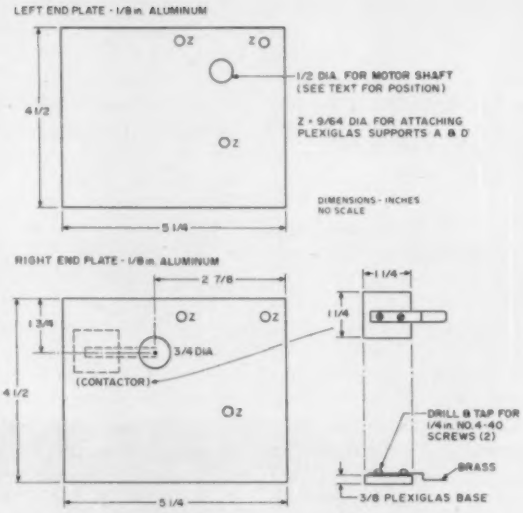


Fig. 10. End plates for paper feed assembly.

Options

If a smaller format is preferred, Alfax paper is available in various widths: 8½, 6-1/8, 5½ inches (¼ inch is to be added to accommodate flange thickness). A 19 inch format with paper feed of 96 lines per inch is more or less standard in facsimile transmissions. Lines per inch are increased with a smaller format, according to the relation:

$$\text{LPI} = \frac{\text{Helix rate (rpm)}}{\text{Paper feed (in./min.)}}$$

One would merely have to rewind the helix, select a paper feed motor with slower rpm (or decrease the diameter of the rollers), and adjust the paper roll supports accordingly.

Acknowledgement

Credit should be given to Lindsay Winkler W6WMI for much of the mechanical detail here. As an inspection of his "Fast Scan FAX System" (March, 1973, *73 Magazine*) will show, I've drawn freely on his ingenious design of helix and paper feed mechanisms. I am indebted to "Wink" and also to Nat Stinnette W4AYV for simplifying the project. ■

References

1. PC boards for this circuit are available from Nat Stinnette W4AYV, P.O. Box 1043, Tavares FL 32778. Undrilled board @ $4.75; $25.95 for a wired and tested unit.
2. Paper, helix wire, and blade (a steel loop) material can be obtained from Alden Co., Westboro MA 01581.

Type	Description	Price
11C01FC	High Speed Dual 5-4 Input OR/NOR	$15.40
11C05DC	1 GHZ Counter Divide By 4	$74.35
11C05DM	1 GHZ Counter Divide By 4	$110.50
11C06DC	UHF Prescaler 750 MHz D Type Flip/Flop	$12.30
11C24DC	Dual TTL VCM	$2.60
11C44DC	Phase Freq. Detector	$2.60
11C58DC	ECL VCM	$4.53
11C70DC	600 MHz Flip/Flop With Reset	$12.30
11C83DC	1 GHZ 248/256 Prescaler	$29.90
11C90DC	650 MHz ECL/TTL Prescaler	$16.00
11C90DM	650 MHz ECL/TTL Prescaler	$24.60
11C91DC	650 MHz ECL/TTL Prescaler	$16.00
11C91DM	650 MHz ECL/TTL Prescaler	$24.60
95H90DC	250 MHz Prescaler	$9.50
95H90DM	250 MHz Prescaler	$16.55
95H91DC	250 MHz Prescaler	$9.50
95H91DM	250 MHz Prescaler	$16.50

THIS MONTH'S Specials

NEW *Fairchild VHF Prescaler Chips*

TUBES

IP21	$19.95	6146A	$4.25
2E26	$4.00	6146B/8298A	$5.50
4X150C	$18.00	6360	$5.50
4X150A	$15.00	6661	$1.00
4CX250B	$24.00	6680	$1.00
4X250F	$22.00	6681	$1.00
DX415	$25.00	6939	$5.50
572B/T160L	$22.00	7984	$3.95
811A	$7.95	8072	$32.00
813	$19.00	8106	$1.95
931A	$9.95	8156	$3.95
4652/8042	$6.95	8950	$5.50
5894	$32.00	6L06	$3.95

7289/2C39A 10 for $12.50

RF TRANSISTORS

New RCA 40290 12.5v, Ft. Typ. 500MHz 2 watts min. at p. in 0.5 watts $2.48

2N2857	$1.85	2N5637	$20.70
2N3375	$7.00	2N6080	$5.45
2N3866	$1.08	2N6081	$8.60
2N4072	$1.50	2N6082	$11.25
2N4427	$1.20	2N6083	$12.95
2N5179	$.68	2N6084	$13.75
2N5589	$4.60	2N6166	$85.00
2N5590	$6.30	MRF511	$8.60
2N5591	$10.35	MMCM918	$2.50

MMT 2857 $2.50/ea

MHz electronics

2543 N. 32ND STREET
PHOENIX, ARIZONA 85008
PH. 602-957-0786

LETTERS

ou goons don't ever proofr
l
b
bunch of rocks
you ignored my comments in
I insist that you print ev

from page 14

was to deliver *73* to me by the first of the month. OK, already! Carumba! Mon Dieu! Mein Gott!

My January issue arrived in early Feb., the Feb. issue arrived four days later, the March issue arrived the third week in Feb., the April issue around March first, and the May issue around March tenth. You win! At this rate I will have the entire 1976 *73 Magazine* by July 4th!

Now, if you guys only published the Field Day results, maybe I could place some bets. Maybe if you published race results . . .

Joe Koziol W1FLX
Pittsfield MA

FCC SLOWNESS

First of all I would like to say that I, for one, like the new format of your magazine and your section on computers. I would like to see more future articles pertaining to the use of minicomputers in ham radio.

Secondly, I would like to comment on the long waits that the FCC puts prospective hams through for the return of tests, licenses, etc.

HERE'S HOW

Richard Matthews, WA4NWW, a local Amateur Radio Operator, and Thomas Harding, a prospective "Ham", make final voltage and resistance on a Heath kit Ham radio built by Matthews. Unlike "CB" radio, the Amateur Operator is free to build and design his own equipment. Matthews is conducting his second Novice Class Amateur Radio class at the Dobbins County Technical School beginning April 1. See story on this page. Photo by Larry Jackson

Ham Radio Classes Are Now Offered

With the boom in "Citizen Band" radio sales skyrocketing, another radio service has seen an increase in popularity due to disgruntled users of the "CB" radio. That service is the Amateur Radio Service or "Ham" as they are frequently called.

Hams come from all walks of life. They are doctors, lawyers, electronics technicians, housewives, students, bums and the executive who have an interest in radio communication and electronics in general.

If you are a Ham now, you may have heard "skip" stations coming in from far off and wished that you could regularly talk with them. On the Ham bands, skip is the accepted practice and communication with other Hams in other countries occur almost daily.

In the Amateur bands, unlike CB, the operator can stay in contact with another station all day long if he wishes and there are talk about any thing they wish as long as they avoid the use of profane language. As a matter of fact one of the most popular awards is Ham radio's "Worked Everywhere" award given for staying in contact with another nation for a solid hour.

But what about technical requirements? Don't you have to learn the international code? The technical part of the Ham license test is really not so difficult. To get the Novice Class (beginners) license, one only needs to know the very basic fundamentals of what electronics is and the few rules and regulations regarding the Novice Class license and operation. As for the code requirement, that is not as difficult as it seems, for thousands upon thousands of Ham's worldwide have learned the radiotelegraph code and enjoy operating their code stations daily, enjoying and communicating with hams worldwide.

Another thing which holds most would be hams from driving into Amateur radio is the cost. Most people have the notion that Ham radio is a "rich man's hobby." This is far from the truth. An any amateur can tell you, a person can put an amateur station on the air cheaper than he can install a Citizen Band base station at today's prices.

In order to interest more people in this area in Ham radio, another class will be conducted by Richard Matthews, WA4NWW, at the J Adams County Technical School. Registration will be 6 p.m. on April 1, at the school.

Matthews will be conducting both a novice class for beginners that will include instruction in learning the radiotelegraph code and basic theory required to pass the FCC examination and a general class for those who already know the code and wish to advance their skill.

For more information on the class and becoming a Radio Amateur, please contact Richard Matthews at 320-0917.

The first novice class that Matthews instructed at the technical school is now waiting patiently for the FCC to send their test so they can hurry up and get on the air and in contact with other hams worldwide.

Recently I passed the Novice class examination and am now waiting patiently for my license to return. After waiting six weeks for my test to arrive (which was supposed to have taken three), I am now steeled to wait another eight weeks or longer for my license return.

I know that the surge in CB licenses has put utter chaos into the offices of the FCC. I would like to suggest that, as many others will agree, something should be done to keep the CB licenses separate from the ham licenses and reduce waiting periods down to tolerable limits.

With CB licenses, no one waits for that coveted piece of paper to arrive before going on the air. As a matter of fact, 99 out of 100 times they will start "ratchetjawing" as soon as they have their set operable.

Not so with ham radio. The prospective ham just sits there listening to the QSOs with a longing in his heart to be able to join in and aggravation in his brain knowing that all that is keeping him from it is the slowness of the FCC.

I would also like to comment on ham radio public relations. I work for the local newspaper in Scottsboro, Al., and we are more than glad to offer PR to hams. All that it takes with most newspapers is to let the editor know of the usefulness of ham radio and to be willing to be interviewed about the subject.

I have enclosed a clipping out of our paper that I wrote as PR for our second Novice and General license study class that is conducted at the local trade school by Richard Matthews WA4NWW. The response was good and helped to secure more students for our second class.

Please start including more building projects for the Novice, as I am sure that there are lots of Novices out there who would appreciate some simple projects to add to their station.

I would also like to take this time to express my appreciation to Richard Matthews WA4NWW, for the patience and understanding he showed in helping me to pass my Novice test.

Now, if my license would only hurry.

Larry Jackson
Section AL

WE ALWAYS GET OUR MAN

A Montgomery Amateur Radio Club member may have averted a tragedy on Monday, March 22, when he observed what appeared to be an assault and possible kidnapping.

The amateur radio operator, Ralph K3CMY, had just emerged from a store on Route 124 near Gaithersburg (MD) when he saw a man cursing and striking a woman. The man then forced the woman into an automobile as she resisted and screamed for someone to call the police. K3CMY reached for the microphone on his mobile FM radio and dialed the Montgomery County Police through the telephone autopatch of the club's Rockville FM repeater station. The car containing the man and woman pulled out onto Route 124 and headed north.

The Montgomery County Police advised Ralph that a patrol car was not immediately available. Ralph volunteered to try to keep the car in sight and the autopatch open. The dispatcher agreed.

On Muncaster Mill Road, near Redland, Ralph spotted a Park Police patrol car and advised the Montgomery County Police dispatcher of this possible source of help. The Park Police stopped the car carrying the man and woman and the Montgomery County officers arrived within moments. The people in the car were taken into custody.

K3CMY was warmly thanked by the arresting officers and the Montgomery County dispatcher for his assistance and the ability of amateur radio to deliver solid communications when the need arose.

At this time no details are known regarding the status of the man and woman who were the object of the chase.

Dave Halliburton WA3ZOR
Gaithersburg MD

DEEP THANKS

Mr. John Meshna
Dear John:

Please accept my deep thanks for sending me one of the last of your "mystery" calculators, as described by J. K. (Jake) Bach in the March, 1976 *73 Magazine*.

By the time I'd read Mr. Bach's article, written him my thanks for a really intriguing story, and received his delightful answer and a fascinating resumé of his background, I could hardly wait to receive a "busted" calculator from you and start to explore its innards, as per Bach.

When U.P.S. delivered your box to me, I was more than ready to pry into its lovely interior, and did so immediately.

The first step was to insert 4 "D" cells and flop it over to see if anything had happened. Voila, everything had happened! It was in full bloom and fully functional, with no open "L1" and no soldering needed.

Over the years, John, you have sent me many real "goodies," but this time you are but the keystone of a triumvirate: I have to thank Wayne Green for publishing your ad and Bach's story, and Mr. Bach for his careful research and manuscript.

C. E. Price W8HPR
Lehigh FL

MORE KUDOS FOR S. D. SALES

More kudos for S. D. Sales – great people to do business with!!!!

Your outlook on CBers is refreshing. (Even made *OST* stand up and take notice!) I found that both CBers and hams have much in common – obnoxious members who curse and just show disrespect for all who share the freqs.; great members who will give their all for someone just to help him out. Both have courteous members who are a pleasure to listen to and who this person looks forward to meeting on the airways (hopefully soon!). The greatest common link is the need to communicate!

Jim Griffin
Las Cruces NM

STOP THE PRESSES!

Stop the presses!! Stop the presses!! I got my April issue in February.

If this keeps accelerating, my brand new three year subscription will run out in August!!

Roy Rehbein WN1VHX
Hopedale MA

LOYAL ARRL MAN

Keep up the good work – I really enjoy your *73 Magazine* – it is really F.B. and tells it like it is.

As a loyal ARRL man, I sometimes get blood pressure rises, but a free press is essential for us to know all sides of every issue affecting our great ham fraternity.

Leo Scanlon WB5OJT
Vicksburg MS

HANG IN THERE

I've been reading, in various radio magazines, letters from readers complaining of the length of time it takes the FCC to process their license applications (or else they think the code requirements are too tough).

I'm writing because I think I have an actual example which might encourage these people to hang in there and be patient.

You have heard the old saying that good or bad, things come in threes.

The first thing was getting my license. After receiving my Novice license, I took the Technician test so that I wouldn't lose my call. However, I never went on the air as a Tech.

Continued on page 158

Vhf engineering

TX144B Kit	transmitter exciter – 1 watt – 2 meters	$ 29.95
TX144B W/T	same as above – factory wired and tested	49.95
TX220B Kit	transmitted exciter – 1 watt – 220 MHz	29.95
TX220B W/T	same as above – factory wired and tested	49.95
TX432B Kit	transmitter exciter 432 MHz	39.95
TX432B W/T	same as above – factory wired and tested	59.95
RX50C Kit	38-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T	same as above – factory wired and tested	114.95
RX220C	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF	accessory filter for above receiver kits give 70dB adjacent channel rejection	8.50
PA2501H Kit	2 meter power amp – kit 1w in – 25w out with solid state switching, case, connectors	59.95
PA2501H W/T	same as above – factory wired and tested	74.95
PA4010H Kit	2 meter power amp – 10w in – 40w out – relay switching	59.95
PA4010H W/T	same as above – factory wired and tested	74.95
PA144/15 Kit	2 meter power amp – 1w in – 15w out – less case, connectors and switching	39.95
PA144/25 Kit	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit	power amp – similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10	10w in – 140w out – 2 meter amp – factory wired and tested	179.95
PA140/30	30w in – 140w out – 2 meter amp – factory wired and tested	159.95
HT144B Kit	2 meter – 2w – 4 channel – hand held xcvr with crystals for 146.52 simplex	129.95
RPT144 Kit	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 kit	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit	repeater – 10 watt – 432 MHz (less crystals)	515.95
RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95
PS3 Kit	12 volt – power supply regulator card	8.95
PS15C Kit	NEW – 15 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above – factory wired and tested	94.95
PS25C Kit	NEW – 25 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T	same as above – factory wired and tested	149.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching	$ 6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX	19.95
Crystals	we stock most repeater & simplex pairs from 146.0-147.0 (each)	5.00

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. **PRICE $67.50**

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. **PRICE $38.50**

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. **PRICE $25.00**

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. **PRICE $15.00**

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weighting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortlessly. The iambic (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

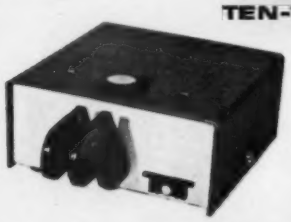
Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing.

PRICE $110.00

SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms
Power Source: 117VAC, 50-60 Hz, 6-14 VDC
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¼"
Weight: 1¾ lbs.

TEN-TEC

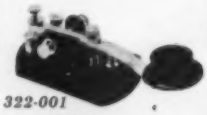


NyeViking

310-003

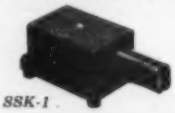
Model 310-001: Standard Key, nickel plated hardware, no switch – $6.65.

Model 310-003: Standard Key, nickel plated hardware, with switch – $8.25.



322-001

Model 320-001: Standard Heavy Duty Key with nickel plated hardware, no switch – $8.20.



SSK-1

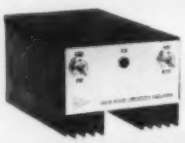
Model 320-003: Same as -001 except with switch – $9.35.

404-002

Model 404-002 SSK-1: Code Practice Set with key – $18.50.

Model 404-002 SSK-1: Chrome Plated – $29.95.

Mobile Amplifiers With Versatility



- Fully VSWR & reverse voltage protected
- No tuning required across band
- Switchable Class C or AB operation
- Built-in TR switching, w/increased delay for SSB
- Fully compatible with all 1-15W FM/SSB/AM/CW rigs
- All solid-state and microstrip construction

SCI **SPECIALTY COMMUNICATIONS SYSTEMS, INC.**

FREQUENCY MHz	MODEL	INPUT POWER NOM.W	OUTPUT POWER NOM.W	OPERATING CURRENT @13.6VDC	SIZE CM HXWXL	RETAIL PRICE
50-54	6M10-100L	10	100	12	7.1X10.2X22.9	$169.95
144-148	2M10-70L	10	70	8	7.1X10.2X16.5	139.95
144-148	2M10-140L	10	140	19	7.1X10.2X26.7	219.95
220-225	1.3M10-60L	10	60	7	7.1X10.2X16.5	159.95
420-450	70CM2-10L	2	10	2	7.1X10.2X16.5	109.95
420-450	70CM10-40L	10	35	6	7.1X10.2X16.5	139.95

TUFTS Radio Electronics

386 Main St., Medford MA 02155
Phone: 617-395-8280

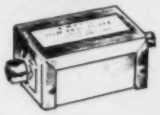
NEW ENGLAND'S FRIENDLIEST HAM STORE

master charge BANKAMERICARD

FILTERS

ELIMINATE INTERFERENCE TO TV SETS WITH AMECO HIGH AND LOW PASS FILTERS

LOW PASS FILTER
MODEL LN-2



The Ameco low pass filter suppresses the radiation of all spurious signals above 40 Mc. It is designed for Coaxial cable (52 to 72 ohms). Other features include: Negligible Insertion Loss, 35 db. and more attenuation of harmonic and spurious frequencies above 50 MC., will handle up to 200 watts of RF power.

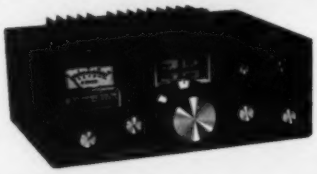
Model LN-2 $6.95

LOW COST HIGH-PASS FILTER MODEL HP-45

Model HP-45 is a single section high-pass filter. All frequencies above 45 MC. are passed through without loss. Other features include: 40 db. and more attenuation at 14 MC. and below; 20 db. attenuation at 10 meters. Negligible insertion loss. $1.95

MOBILE COMMUNICATIONS FILTERS FOR VENICULAR AND MARINE ELECTRICAL SYSTEMS

AF-104	Alternator Filter, non-tunable	$ 4.90
C-20	Feed-thru Coax Filter, .1 mf	2.58
C-40	Feed-thru Coax Filter, .5 mf	4.06
C-70	Same as C-40, except 70 amps.	4.78
CB-330	Generator Filter, 3-30 MHz, Hi-amp.	4.90
G-23	Marine Generator Filter, Tunable	7.64
HF-3060	Generator Filter, Hi-amp., 30-60 MHz	4.90
T-52	Tunable Alt. Filter, 52A, 22-60 MHz	12.59
T-70	Tunable Alt. Filter, 70A, 22-60 MHz	13.14
TH-70	Tunable Alt. Filter, 70A, 100-200 MHz	13.14
TM-49	Tunable Marine Alternator Filter, 49A	13.14
TM-68	Tunable Marine Alternator Filter, 68A	13.69
VF-225	Voltage Regulator Filter	4.90



THE ATLAS 210x/215x

- Solid state SSB/CW transceivers
- 200 watts P.E.P. input
- No transmitter tuning
- The ultimate in sensitivity, selectivity, and overload immunity.
- Plus extended frequency coverage for MARS operation when used with 10x crystal oscillator.

210x or 215x	$649.
210x or 215x with noise blanker	$689.
AC Console 110/220V	$139.
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Plug-in Mobile kit	$ 44.
10x Osc. less crystals	$ 55.

DENTRON

160-10AT SUPERTUNER™

Want an antenna tuner to match everything between 160 and 10 through balanced line, coax line and random line, pump out the full legal limit and look and sound good doing it? Supertuner™ is the one for you at just **$119.50**

160-10AT-3K SUPER SUPERTUNER™

Designed and engineered to be compatible with the full-power highly efficient modern amplifiers now available to the amateur. In our opinion the finest tuner on the market today. **$229.50**

80-10AT SKYMATCHER™

Here's an antenna tuner for 80 through 10 meters, handles full legal power and matches your 52 ohm transceiver to a random wire antenna. 80-10AT is yours for only **$59.50**

talk power by TPL

TPL for an Economy Price? THAT'S RIGHT! introducing the ECONO-LINE

Model	Input	Output	Typical	Frequency	Price
702	5-20W	50-90W	10 in/70 out	143-149 MHz	$139.00
702B	1-4W	60-80W	1 in/70 out	143-149 MHz	$169.00

Now get TPL COMMUNICATIONS quality and reliability at an economy price. The new Econo-Line gives you everything that you've come to expect from TPL at a real cost reduction. The latest mechanical and electronic construction techniques combine to make the Econo-Line your best amplifier value. Unique broad-band circuitry requires no tuning throughout the entire 2-Meter band and adjacent MARS channels. See these great new additions to the TPL COMMUNICATIONS product line at your favorite amateur radio dealer.

For prices and specifications please write for our Amateur Products Summary.

TPL COMMUNICATIONS INC.

FCC type accepted power amplifiers also available. Please call or write for a copy of TPL's Commercial Products Summary.

PREAMPLIFIERS

AMECO

MODEL PT ALL BAND FRAME GRID PRE-AMP FOR 6 thru 160 METERS

A continuous tuning 6-160 meter pre-amp specifically designed for use with a transceiver. Features a frame grid pentode to provide a low noise figure with the ability to handle strong signals, greatly improving the sensitivity of the receiver section of a transceiver. A unique built-in transfer circuit enables the PT to by-pass itself while the transceiver is transmitting. The PT also feeds the antenna input of a 2nd receiver as well as muting it. Front panel control transfers antenna and control circuitry "in-and-out" at will, thereby providing master power control for the entire station. Four AC power outlets at the rear of the unit are controlled by the "master" ON-OFF switch at the front panel. A built-in attenuator provides variable off channel signal protection.

Model PT 117V AC, 60 Hz. $69.95
Model PTE 220-240V AC, 50-60 Hz. $76.95

ALL BAND PREAMPLIFIERS

- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp.

Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

MODEL PCLP is identical in all respects to the PLF except that two nuvistors are used instead of the FET.

Model PCLP 117V AC, 60 Hz. Wired & tested $39.00

UHF RF CONNECTORS

A B C D E

Low loss R-F connectors for Amateurs, Citizens Band and laboratory use. Silver plated for high RF conductivity.

A	PL-259	Coaxial Plug	$ .80
B	SO-239	Coaxial Receptacle	.68
C	M-359	Coaxial Right Angle Adapter	2.29
D	PL-258	Coaxial Junction	1.31
E	UG-175/U	Adapter for RG-58/U	.25
	DM	Double Male Plug	1.60

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Mail your order to Distributor: TUFTS RADIO, 386 Main St., Medford, Mass. 02155. Phone (617) 395-8280

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Name _____ Address _____

City _____ State _____ Zip _____

(Prices F.O.B. Medford, Mass. All units can be shipped U.P.S. Mass. residents add 5% sales tax.)

TUFTS

Radio Electronics

386 Main St., Medford MA 02155
Phone: 617-395-8280

NEW ENGLAND'S FRIENDLIEST

HAM STORE

6 METER BEAMS

3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated u-bolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

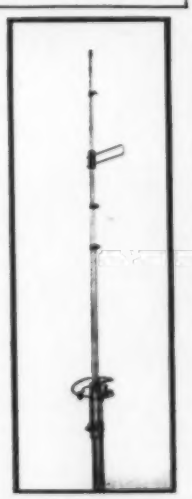
New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Lngth	8'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	8'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	26 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

new
RINGO RANGER for FM

4.5 dB* — 6 dB**
Omnidirectional
GAIN
BASE STATION
ANTENNAS

FOR MAXIMUM PERFORMANCE AND VALUE



Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A FM RINGO 2.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install. 6 meter partly preassembled, all but 450 MHz tube 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-450
Power—Hdlg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.27'	.20'	.10'

5-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 33' 220 MHz — 16', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.88 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.82 sq. ft.
AFM-44D 420 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK. complete 4 element stacking kit
A14-SK. 4 element coax harness only
A147-VPK. complete 11 element stacking kit
A147-SK. 11 element coax harness only
A449-SK. 6 + 11 element coax harness only

5-4-5-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be lower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/40"	44"/40"	60"/13"	35"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 19"	5 lbs., 51"
Gain/F/B ratio dB	13.2/28	9/20	13.2/28	11/25	13.2/28
½ Power beam	42°	66°	46°	60°	46°
Wind area sq. ft.	1.21	.43	.58	.30	.59
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 120", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.43 sq. ft.

HIGH PERFORMANCE VHF YAGIS

3/4, 1-1/4, 2 METER BEAMS

The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O.D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O.D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144-7	A144-11	A220-11	A430-11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	66"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ ½ pwr. pt.	46°	42°	42°	42°
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

VHF/UHF BEAMS			
A50-3	$ 27.50	A144-7	19.95
A50-5	39.50	A144-11	24.95
A50-6	59.50	A430-11	19.95
A50-10	89.50		

AMATEUR FM ANTENNAS			
A147-4	$ 15.95	AFM-44D	47.50
A147-11	24.95	AR-2	18.50
A147-20T	47.50	AR-6	24.50
A147-22	69.50	AR-25	21.50
A220-7	18.95	AR-220	18.50
A220-11	22.95	AR-450	18.50
A449-6	15.95	ARX-2	28.50
A449-11	21.95	ARX-2K	11.95
AFM-4D	53.50	ARX-220	28.50
AFM-24D	49.50	ARX-450	28.50

TouchTone pad for the SR-146A— plugs into the PL socket. $75 complete with level level control.

- *Remote*
- *Motor Controlled*

RCS-4

- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. **Price: $120.00**

MATCHING NETWORKS

MN-4
200 watts
Price: $110.00

MN-2000
2000 watts PEP
Price: $120.00

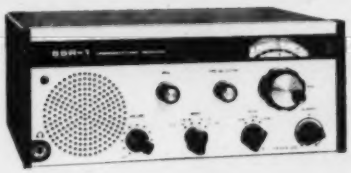
General: • **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power • **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 • Covers ham bands 80 thru 10 meters • **Switches in or out** with front panel switch • **Size:** 5½"H, 10¾"W, 8"D (14.0 x 27.3 x 20.3 cm), MN-2000, 14¼"D (36.5 cm).
• **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) • **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.

RF WATTMETERS

W-4 1.8-54 MHz **Price: $ 72.00**
WV-4 20-200 MHz **Price: $ 84.00**

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3¾"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts	±(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)



SSR-1 COMMUNICATIONS RECEIVER

- **Synthesized • General Coverage**
- **Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands**
- **Excellent Performance**

PRELIMINARY SPECIFICATIONS: • **Coverage:** 500 kHz to 30 MHz • **Frequency** can be read accurately to better than 5 kHz • **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM • **Selectable sidebands** • **Built-in power supply:** 117/234 VAC ± 20% • **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) • **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.

The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.

Price: $350.00

POWER SUPPLIES
AC-4 Power Supply $120.00
DC-4 Power Supply 135.00

GENERAL: • **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges • **Solid State VFO** with 1 kHz dial divisions • **Modes** SSB Upper and Lower, CW and AM • **Built-in Sidetone** and automatic T/R switching on CW • **30 tubes and semi-conductors** • **Dimensions:** 5½"H, 10¾"W, 14¾" D (14.0 x 27.3 x 36.5 cm), **Wt.:** 16 lbs. (7.3 kg).

TRANSMIT: • **VOX or PTT** on SSB or AM • **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts • **Adjustable pi-network.**

RECEIVE: • **Sensitivity** better than ½ μV for 10 dB S/N • **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. • **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression • **Diode Detector** for AM reception. **Price: $599.00**

34-PNB Plug-in Noise Blanker 100.00
FF-1 Crystal Control Unit 46.95
MMK-3 Mobile Mount 7.00
RV-4C Remote VFO 120.00

TR-4C SIDEBAND TRANSCEIVER

TR-22C 2-METER FM TRANSCEIVER

Completely transistorized, compact, portable 2-meter VHF-FM transceiver with capacity for 12 channels can be used over the shoulder, mobile, or in your home. Built-in telescoping antenna, and SO-239 connector for external antenna. Works barefoot or with accessory two-way amplifier. Uses external 12 VDC or internal rechargeable ni-cad batteries. Built-in 120 VAC 50-60 Hz battery charger.

GENERAL: • **Frequency Coverage:** 144 through 148MHz. 12 Channels, 2 supplied: (1) Receive: 146.52 MHz, Transmit: 146.52 MHz; (2) Receive: 146.94 MHz, Transmit: 146.34 MHz • **Power Requirements:** 13.0 Volts DC ± 15% • **Current Drain:** Transmit: 450mA, Receive: 45mA • **Antenna Impedance:** 50 Ohms • **Dimensions:** 5¾" x 2⅝" x 7½" (13.6 x 5.8 x 19.1 cm) • **Weight:** 3.75 lbs (1.7 kg)

RECEIVER: • **Sensitivity:** Typically .5 microvolt for 20 dB quieting • **IF Selectivity:** 20 kHz at 6 dB down; ±30 kHz ±7kHz. • **Audio Output:** At least 1 Watt at less than 10% distortion • **Audio Output Impedance:** 8 Ohms

TRANSMITTER: • **RF Output Power:** 1 Watt minimum • **Frequency Deviation:** Adjustable to ±10 kHz maximum, factory set to 6.0 kHz. • **Multiplication:** 12 Times

Price: $229.50

Including Dynamic Mike, Over-the-Shoulder Carrying Case, 120 VAC and 12 VDC Cords, Speaker/Headphone Plug, and 10 ni-cad Batteries.

channel rejection greater than 75 dB down. • **First IF:** 10.7 MHz with 2-pole monolithic crystal filter. • **Second IF:** 455 kHz with ceramic filter. • **Intermodulation Response:** At least 60 dB down. • **Modulation Acceptance:**

ACCESSORIES

Accessory Crystals • **Model MMK-22 and MB-22 Mobile Mounts** for TR-22C

Model AA-10 Power Amplifier • Use with TR-22C or any transceiver with up to 1.8 watts output power. • 10 dB power increase • At least 10 watts output @ 13.8 VDC. • No relays — automatic transmit/receive switching • Small size
Price: $ 49.95

Model AC-10 Power Supply. Powers the AA-10 and TR-22C
Price: $ 49.95

DRAKE

TVI MAY BE ELIMINATED WITH THESE DRAKE FILTERS

Drake Amateur Low Pass Filters

Have four pi sections for sharp cut-off and to attenuate unwanted harmonics falling in any TV channel and the FM band. 52-ohm.

TV-5200-LP (formerly TV-1000-LP) rated 1000 watts input, 200 watts on 6 meters. SO-239 connectors built-in. **$19.95**

TV-3300-LP 1000 watts max. below 30 MHz. Attenuation better than 60 dB above 41 MHz. **$19.95**

TV-42-LP is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for citizens band and other transmitters 30 MHz and lower. Rated 100 watts input. SO-239 connectors built-in. **$10.95**

TV-300-HP High Pass Filter provides more than 40 dB attenuation at 52 MHz and lower. Protects the TV set from amateur transmitters 6 thru 160 meters. **$ 9.95**

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Get on the air NOW! Let Tufts put you there!

Standard Communications

Horizon 2
25 Watts, 12 Channels — **Walkie Talkie 146 A**

Penny Pincher 146A all XTALS (Specify three frequencies) $298.00

34/94	94/94			

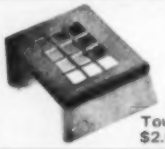
SCOTCH TREAT SPECIAL as above includes rubber ducky antenna.
Nicads with base charger $335.00

SCOTCH DELUXE as above plus Deluxe carrying case $349.00
THE WORKS: all channels your choice spare Nicad Battery pak $400.00

Touch Tone mounted on back with plug which will mate to PL deck – $75 each. Avail. separately or with purchase.

MOBILE DELIGHT — HORIZON 2
6 channels your choice — 5/8 wave gain antenna
Trunk lip or roof mount your choice $295.00

MOBILE DELIGHT DELUXE as above but all channels your choice $325.00



Touch Tone Enclosures
$2.95 @. Colors: Beige, Grey, Black

BOMAR Crystal Company

CRYSTALS IN STOCK

Standard	Icom	Heathkit	Ken	Clegg
Regency	Wilson	VHF Eng	Drake	And Others

$4.00 each – LIFETIME GUARANTEE

Make/Model	Xmit Freq.	Rec. Freq.

Please enclose $2.00 for shipping with your order.

THE FIRST AND STILL THE LEADER!

the IC230 $489.00

Put Over 67 Channels in the Palms of Your Hands

SPECIAL FEATURES:
- No more Crystals . . . Over 67 . . . fully synthesized channels available.
- All Channel Capability . . . Travel with confidence that you'll be able to work all repeaters along the way.
- Super Compact . . . 2.28" high x 6.14" wide x 9.72" deep at a weight of only 5.5 lbs.
- Quick Disconnect Mobile Mount . . . Allows quick car installation.
- Easy Operation . . . Punch up frequency, select repeater or simplex mode, and you're on the air. (A crystal may be added for a unique repeater frequency.)
- Modular Construction . . . In case of a problem, modules can easily be removed and sent for repair. A replacement module will be air mailed to minimize down time.
- Super Hot Receiver . . . Better than .4uv/20db sensitivity, helical filters to eliminate intermod . . . plus a super E filter and a mosfet front end.

If There Is A Signal, You'll Hear It On The IC-230!

$50 Merchandise Credit with each IC-230

3/8" single hole mount

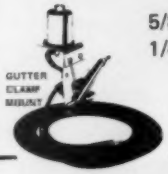
5/8 wave $31.50
1/4 wave 11.50

Larsen Antennas

Larsen Antennas to fit Any Mobile Unit

Magnetic Mount or Gutter Clamp
Specify, 2 meters, 220, 450.

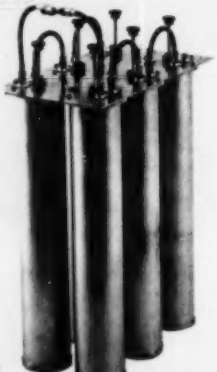
5/8 wave – $38.50
1/4 wave – $18.50



NORTH SHORE RF TECHNOLOGY

The Originators of DUPLEXER "KITS"

100's Already Sold to HAMS!



NOW...INTRODUCES ALL NEW IMPROVED MODELS

- Easier than ever to assemble and tune • Rugged construction • Easy maintenance • Low cost

MODEL: 60-3...4 cavity, freq. range, 140 to 170 MHz, isolation 90db max., insertion loss 0.8db min., freq. spacing 450 KHz min., impedance 50 ohms, power rating 350 watts continuous, temp. stable over wide range. Shipping weight 30 lbs. Size 20" x 8-3/4" x 19". Rack mount. **Price $349.**

MODEL: 6309-3...4 cavity, freq. range 220 to 240 MHz, isolation 80db max., insertion loss 0.8db min., freq. spacing 1.3 MHz min., impedance 50 ohms, power rating 350 watts continuous, temp. stable over wide range. Shipping weight 30 lbs. Size 17" x 8-3/4" x 19". Rack mount. **Price $349.**

MODEL: 6409-3...4 cavity, freq. range 430 to 500 MHz, freq. spacing 3 MHz min., isolation 80db max., insertion loss 0.8db min., impedance 50 ohms, power rating 350 watts continuous, temp. stable over wide range. Shipping weight 30 lbs. Size 15" x 8-3/4" x 19". Rack mount. **Price $349.**

Individual cavities...**$85 each.**

NOW You can get first hand knowledge on how a DUPLEXER works by assembling it yourself and save money, too!

ALL these kits can be assembled and tuned in one evening by following easy to read manual.

NEW INTERDIGITAL BAND PASS FILTER KITS:

All models power rating 250 watts with insertion loss 1db.

MODEL: 60-2...Freq. range 144 to 148 MHz adjustable, 1db band with 2 MHz, 60db band with 10 MHz. Size 1" x 20" x 10". **Price $30.**

MODEL: 60-220...Freq. range 220-225 MHz adjustable, 1db band with 2.5 MHz, 60db band with 12.5 MHz. Size 1" x 15" x 10". **Price $30.**

MODEL 60-440...Freq. range 430 to 450 MHz adjustable, 1db band with 5 MHz, 60db band with 25 MHz. Size 1" x 7" x 10". **Price $30.**

MODEL: 60-9...6 cavity, freq. range, 140 to 170 MHz, isolation 100db max., insertion loss 0.6db min., freq. spacing 450 KHz min., impedance 50 ohms, power rating 350 watts continuous, temp. stable over wide range. Shipping weight 40 lbs. Size: 20" x 10-1/2" x 19". Rack mount. **Price $349.**

THE PERFORMANCE of all units are equal to or better than any commercially manufactured units.

ALL PARTS are professionally made to insure you of first quality performance.

NORTH SHORE RF TECHNOLOGY

Mail your order to Distributor: TUFTS RADIO, 386 Main St., Medford, Mass. 02155. Phone (617) 395-8280

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Name _____ Address _____
City _____ State _____ Zip _____

(Prices F.O.B. Medford, Mass. All units can be shipped U.P.S. C.O.D. orders require $50 deposit. Mass. residents add 5% sales tax.)

AMPHENOL

SERIES 581 — PACKAGED CABLE ASSEMBLES

All popular lengths are now available in your choice of RG 8/U or RG 58/U type low loss polyfoam dielectric cable. Installed PL-259 connectors are ASTROplated® — Amphenol's new non-tarnishing finish — which has all the advantages of precious metal plus more heat, corrosion and abrasion resistors that silver ever had!

RG 58/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES

581-5803: 3-ft. with ASTROplated PL-259's on both ends. . . . . $ 3.82
581-5812: 12-ft. with ASTROplated PL-259's on both ends. . . . . $ 5.08
581-5820-2: 20-ft. with ASTROplated PL-259's on both ends. . . . . $ 5.88
581-5850: 50-ft. with ASTROplated PL-259's on both ends. . . . . $ 8.94
581-5875: 75-ft. with ASTROplated PL-259's on both ends. $11.22
581-58100: 100-ft. with ASTROplated PL-259's on both ends. $12.98

RG 8/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES

581-803: 3-ft. with ASTROplated PL-259's on both ends. . . . . $ 4.46
581-820: 20-ft. with ASTROplated PL-259's on both ends. $10.36
581-850: 50-ft. with ASTROplated PL-259's on both ends. $18.58
581-875: 75-ft. with ASTROplated PL-259's on both ends. $25.48
581-8100: 100-ft. with ASTROplated PL-259's on both ends. $31.96

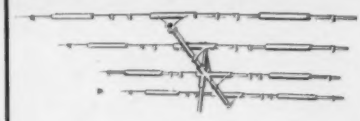
why waste watts?

SWR-1 guards against power loss for $21.95

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Get it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN ELECTRONICS



High-Q Fixed Antennas

All Swan Beam Antennas are Rated for 2000 Watts and Designed to use 52 Ohm Coaxial Feedlines

HEAVY DUTY 4-ELEMENT TRIBAND BEAM.

Four working elements on each band in 10, 15 and 20 meters. 24 foot boom permits optimum spacing for maximum forward gain and front-to-back ratio. All traps are precision tuned and weather-proofed. Rugged reliability assures ability to withstand winds up to 100 mph. TB-4HA.

HEAVY DUTY 3-ELEMENT TRIBAND BEAM.

Three working elements on each band in 10, 15 and 20 meters. 16 foot boom requires a lighter duty rotor and tower than the TB-4HA but still provides excellent performance characteristics. Precision tuned and weather-proofed traps are combined with rugged construction. TB-3HA.

ECONOMICAL 2-ELEMENT TRIBAND BEAM.

Two working elements on each band in 10, 15, and 20 meters. 6.5 foot aluminum boom can easily be raised on an inexpensive mast and operated with a standard TV rotator. Withstands winds up to 80 mph. TB-2A.

HEAVY DUTY 2-ELEMENT 40-METER BEAM.

Two working elements on 15.75 foot steel boom. Maximum forward gain and front-to-back ratio in the CW or phone portion of the 40-meter band is easily achieved for optimum performance. Large high-Q loading coils are weather-proofed. Rugged design easily takes 100 mph winds. MB-40H.

SWAN ELECTRONICS

SWAN BEAM ANTENNA SPECIFICATIONS

Antenna Model Number:	Average Forward Gain:	Front to Back Ratio:	Boom Length & Diameter	Longest Element:	Turning Radius:	Maximum Wind Survival:	Wind Load @ 80 mph:	Wind Surface Area:	Net Weight Assembled:	Cost:
TB-4HA	9 dB	24-26 dB	24' x 1.5"	28'-10"	18'-6"	100 mph	148 lbs.	6 sq. ft.	54 lbs.	$249.95
TB-3HA	8 dB	20-22 dB	16' x 1.5"	28'-2"	18'	100 mph	110 lbs.	4 sq. ft.	44 lbs.	189.95
TB-2A	5 dB	16-18 dB	6.5' x 1.5"	27'-8"	14'-3"	80 mph	60 lbs.	1.8 sq. ft.	18 lbs.	129.95
MB-40H	4 dB	16-18 dB	15.75' x 1.5"	30'-4"	17'-6"	100 mph	80 lbs.	2.5 sq. ft.	40 lbs.	199.95

VHF/UHF ANTENNA— ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U. $10.16

TWO AND SIX METERS— TRUNK LIP MOUNT
MODEL MFT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259. $21.45

VHF/UHF ANTENNA— TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. $15.96

DELUXE MOBILE MOUNTS
For medium length, light weight antennas with ⅜"—24 base.

MODEL TLM
Trunk lip mount for no holes installation or side or edge of trunk lid. Includes 17' RG-58-U connectors attached. $12.95

MODEL MLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. $14.95

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. $7.50

MODEL MM-1
Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors. $ 6.45

MODEL TSM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. $7.50

MODEL O-30
Ball mount complete with mounting hardware. $3.79

HUSTLER

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MODEL BF-2
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STANDARD GAIN MOBILES
Two Meters
- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL BBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $28.75

MODEL BBL-144
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New design is rugged for supporting Hustler antenna with standard or Super resonators. Includes one GSM-2 ball mount and clasp from stainless steel. $24.95

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MODEL 63-144 — ⅝ wave, two-meter antenna. Includes radials for complete decoupling. SWR at resonance: 1.5:1 or better. Height: 48". Power rating: 200 Watts FM. $21.95

SUPER GAIN MOBILES
Two Meters
- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

MODEL CGT-144
Get big signal performance, superior receiving capability with this 95" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259. $39.95

MODEL CG-144
Same characteristics as CGT-144 supplied with ¾"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included. $28.75

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MODEL BBM-2
Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cylinder base, steel back-up plate and mounting hardware. $13.50

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MODEL QD-1
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Get factory performance, maximum coupling for maximum home pick-up in this MIL SPEC 96 length of RG-58-U cable. Supplied with connectors attached for use with baluns or bumper mount and transceiver. $ 7.45

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All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD HUSTLER RESONATORS— Power Rating: 400 watts SSB

Model	Band	Price
RM-10	10 meters	$10.75
RM-15	15 meters	$11.75
RM-20	20 meters	$12.75
RM-40	40 meters	$15.95
RM-75	75 meters	$16.95
RM-80	80 meters	$16.95

SUPER HUSTLER RESONATORS— Power Rating: Legal Limit SSB Supers have widest band-width

Model	Band	Price
RM-10-S	10 meters	$13.95
RM-15-S	15 meters	$14.95
RM-20-S	20 meters	$15.95
RM-40-S	40 meters	$23.95
RM-75-S	75 meters	$29.95
RM-80-S	80 meters	$29.95

RM5 RM 4-BTV

Covers 10 - 15 - 20 - 40 Meters
Only Hustler Gives One Setting for Whole Band Coverage

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- All sections 1¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
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- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5" Weight: 15 lbs.
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For 6 - 10 - 15 - 20 - 40 - 75 - 80 Meters

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For bumper mounting—Fold is at roof line 27" above base. $15.95

MODEL MO-1
For deck or fender mounting—Fold is at roof line 13" above base. $15.95

MO-1 MO-2

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Der Repeatermeister

-- then get satellite pictures and other things

As I promised in an earlier article, here is the conclusion to the construction of a 220 MHz repeater. It is the control system I designed to operate any repeater with minimum attention. Once put into operation, there should be no need to ever service the control system, except for changing the ID.

This system consists of two main PC boards, the timer control and the ID. The timer board contains all the necessary circuitry for the complete and unattended operation of a remote repeater with provisions for timeout reset, instant dropout, and autopatch access and de-access with adjustable timers. The timers consist of two NE556s and one NE555 which are set up to control the transmit keying transistor. The timing functions are: autopatch timer, timeout timer, tail timer, ID timer, and what I call a receiver off timer.

The CW identifier is an improvement on the circuit in the *FM and Repeaters Handbook* published by the ARRL. It can be found on pages 136 and 137 (1972 edition). I didn't understand the clock oscillator and stop logic circuit, so I redesigned it to operate with the control board I had designed. However, it will function on its own quite well and will interface with almost any existing control system. Also, it's dirt cheap to build. Depending on where you get the 8223, total cost for parts is about $7.00. In fact, the whole system should only set you back about $30.00, which is cheaper than a certain CW ID kit I know of using diodes for programming.

Both boards are single-sided and four and three-quarters inch square so they may be stacked to save space. I really hate using a lot of jumper wires, but it's easier than trying a double-sided board. I admit that I'm not that good at making PC boards yet. If the boards are used separately, there is provision for using an LM309K on each; if used together, one may be eliminated and a jumper installed from the board with the regulator. Total current drain is around 400 mils, which is well within the ratings of the LM309K.

The nice thing about using a PROM is that it can be custom programmed in the field. Several magazines have published articles on programming the 8223, the best one having appeared in Popular Electronics, July, 1975, page 27. Once you get

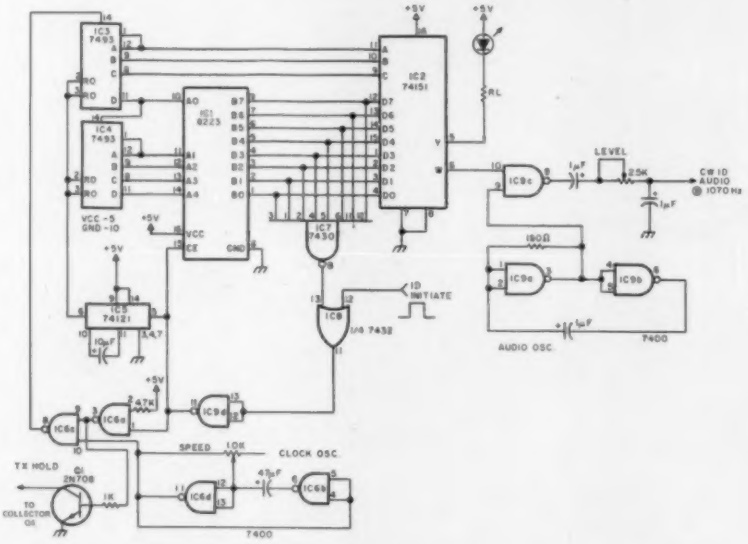

Fig. 1. PROM CW ID. Program note: Dit — 0 — Space in same letter 1; Dah — 000 — Space between letters 111; Space between words 11111 or 111111.

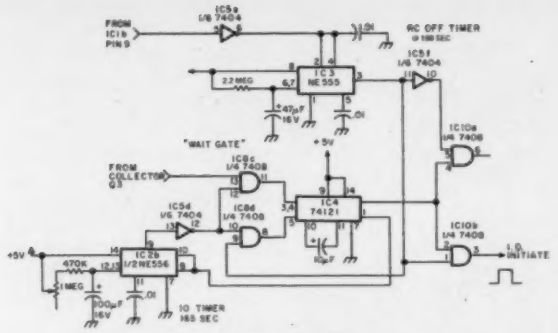

Fig. 2. "Smart" ID Timer.

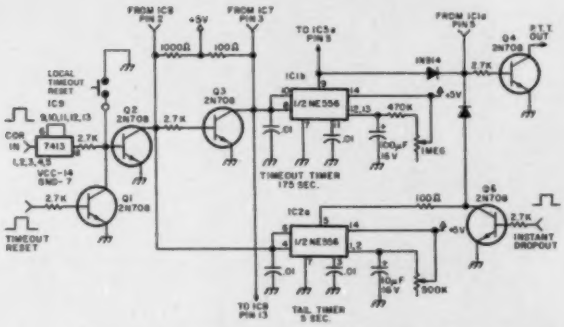

Fig. 3. Timeout and Tail Timer.

used to the procedure for programming, it only takes about five minutes to do the whole chip.

PROM CW ID

The changes made to this circuit are simple. Rather than the stop logic the original had, I used a 7430 8-input NAND gate. This chip will give a logic 0 output for all 1 inputs. The 7432 will decode the 0 from the 7430 and the 0 on the ID Initiate input and give a 0 output which is inverted by IC9d to fire the one-shot, resetting the two counter ICs to zero, and also puts a high on the Chip Enable of the 8223 which puts all the outputs to a logic 1, thus ensuring that the ID circuit stays stopped until initiated again by a logic 1 pulse.

This is very important. Program the 8223 with reverse logic. If you want a tone, the output of the 8223 must be a 0. Also, make sure that no set of outputs is all logic 1s, because this is the stop word. Try to arrange the programming in such a way that at least one output per word is a 0. Example: DE WA1UFE. Word 0 – 1000111, word 1 – 0111010, word 2 – 1011111, word 3 – 0001000, etc. The words read from right to left. That is, B7, B6, B5, B4, B3, B2, B1, B0. Of course, the stop word, 1111111, can be programmed anywhere in the chip, but should be immediately after the message.

A "Smart" ID Timer

This is the best part of the whole design. I wanted an ID that would not come on over someone's transmission, would wait until the carrier dropped, would have to ID on initial keyup, ID after a timeout, and ID once after repeater usage ceased. This one does it all.

IC2b and IC4 are connected as a self-resetting timer. But the gates marked "wait gate" control the resetting of the timer. Assume that IC3 has timed out. This puts a low on pin 9 of IC8, which puts a low on pin 5 of IC4. If there is no signal being received, pin 13 of IC8 is also low. As soon as IC2b times out, pins 10 and 12 of IC8 go high. Now the circuit is "waiting." Backing up a bit, IC3 is timed out because pins 2 and 4 see a

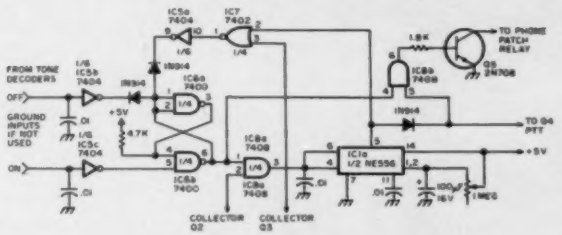

Fig. 4. Autopatch Timer.

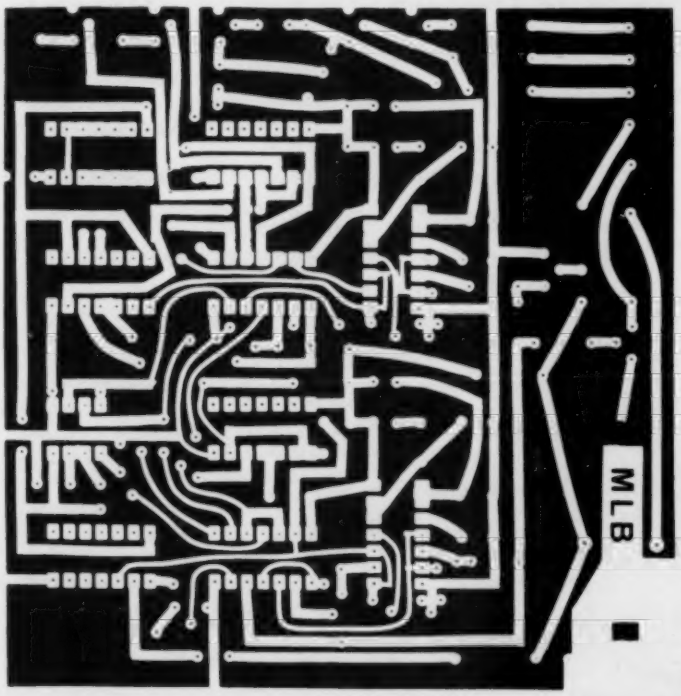

Fig. 5. Master logic board (full size).

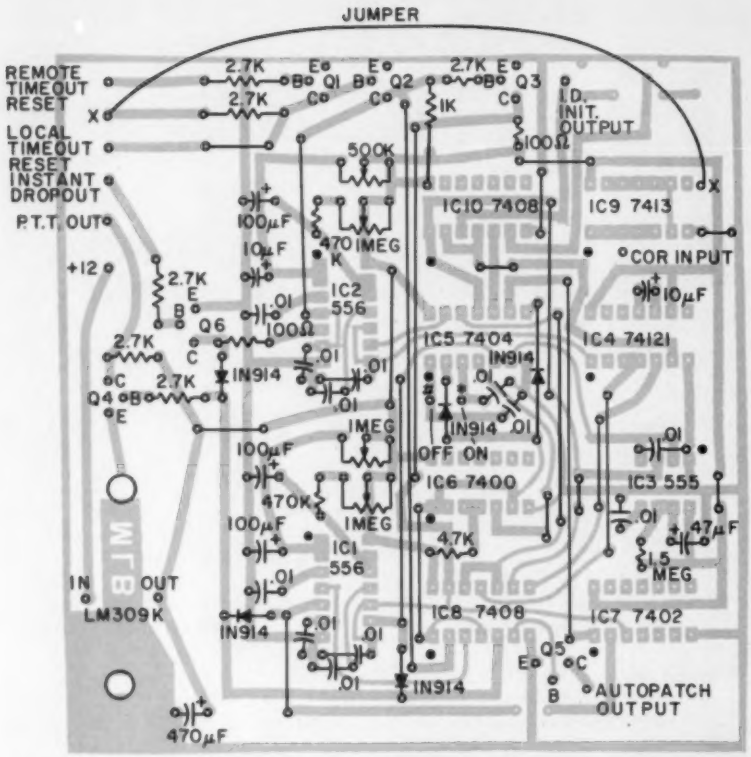

Fig. 6. Component side, master logic board. Dot identifies pin 1. Drill two small holes near input and output of IC9 and add jumper shown. Use insulated wire. Also use insulated wire for the long jumpers.

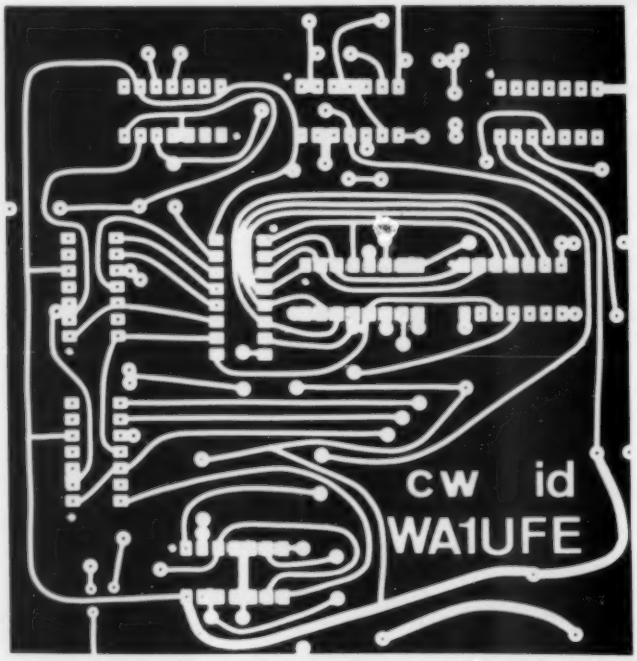

Fig. 7. CW ID board (full size).

high. As soon as the input goes low, the timer is reset, and will start timing as soon as the input goes high again. Now, suppose a signal is received. Pin 13 of IC8 goes high, and since pin 12 is high, a high is put on pins 3 and 4 of IC4. Nothing happens yet since pin 5 is still low. As soon as the signal drops, pins 3 and 4 go low and IC3 starts timing again, putting a high on pin 9 of IC8, which puts a high on pin 5 of IC4 and fires the one-shot which initiates the ID and resets IC2b. A similar sequence occurs during repeater usage, time-out, and final ID.

The reason for IC10a: I was trying to get an exclusive output for use with a voice ID circuit; logically, it should work, but practically, it doesn't.

Timeout and Tail Timer

A simple enough circuit: two timers working out of phase with each other. IC1b is set to control the transmitter on-time, which is variable from about 1 minute to 3½ minutes. IC2a is set to time out at 5 seconds and is reset each time the receiver squelch is broken. If no tail is wanted, a logic one at the base of Q6 will short the output of IC2a to ground through the 100 Ohm load resistor.

I found that I needed a Schmitt Trigger input. It seems that when the receiver's squelch is broken, the squelch gate generated a burst of noise that caused false triggering of the ID timer. Adding the 7413 cured the problem. A logic one on the COR input is needed to key the transmitter.

Q1 is used for remote timeout reset, which can be controlled from the remote control receiver and tone decoders. A short logic one pulse will momentarily ground the base of Q2, resetting all the timers.

Q4 is the transmitter

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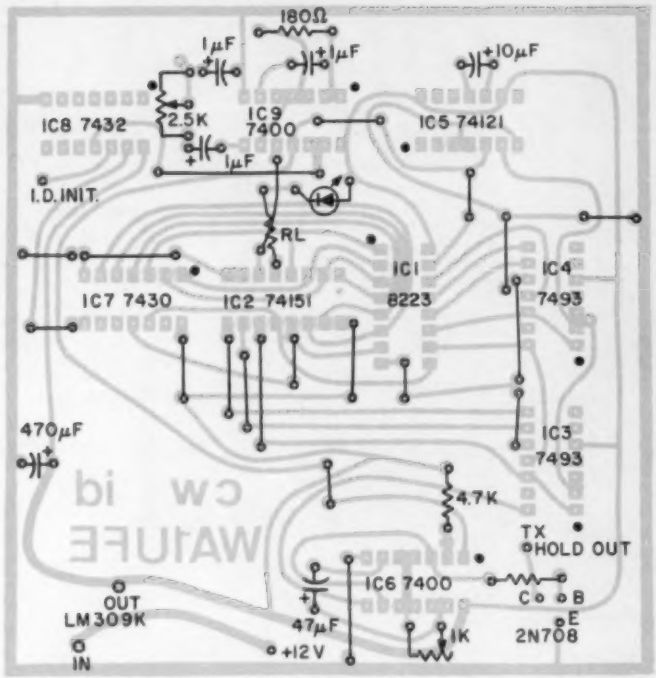

Fig. 8. Component side, CW ID. Dot identifies IC pin 1.

keying transistor. The collector is grounded when active, so this will work with relay keying or the solid state keyer I used in the repeater I built. If the transmitter being controlled uses a 120 volt relay, substitute a high voltage transistor for the 2N708 used here. I assumed a solid state repeater.

Autopatch Timer

Since autopatch is becoming more popular on repeaters these days, I decided to include a timing circuit for it, also. This circuit will allow an adjustable time delay in the receive mode (for the user). It is adjustable from about 30 seconds to over 90 seconds. If someone should access the patch and for some reason not be able to transmit again, once IC1a times out, it will automatically drop the phone line and reset itself so that one would have to re-access. The time-out on the user's transmission is limited by the normal time-out period.

Logic one inputs are required to enable and disable the timer. Not knowing what every repeater uses as tone decoders, I purposely designed it to be flexible. This will also allow any access code one wants to use, if other than * for access and # for de-access: single tone or sequential tone or whatever, as long as the circuit being used can provide a logic one output.

Not being familiar with phone patches, I decided on an uncommitted collector output. I am, of course, assuming that a phone patch has a relay in it that can be energized by grounding one side of the coil.

If this portion of the control board is not needed or not used, note that the inputs must be grounded; otherwise, the transmitter will latch on transmit. ■

Parts List — Logic Board

ICs	Resistors
1 7400	2 100 Ohm ½ W
1 7402	1 1k ½ W
1 7404	5 2.7k ½ W
2 7408	2 4.7k ½ W
1 74121	2 470k ½ W
1 NE555	1 500k Trimpot
2 NE556	3 1 Meg Trimpot
1 LM309K	1 1.5 Meg ½ W

Capacitors	Diodes
12 .01 uF disc	5 1N914
2 10 uF 16 V	
1 47 uF 16V	Transistors
3 100 uF 16 V	6 2N708 or similar
1 470 uF 16 V	

Parts List — CW ID

ICs	Resistors
2 7400	1 180 Ohm ¼ W
1 7430	1 470 Ohm ¼ W
1 7432	1 1k ¼ W
2 7493	1 4.7k ¼ W
1 74121	1 2.5k Trimpot
1 74151	1 1k Trimpot
1 8223	
1 LM309K	

Capacitors	Transistor
? .01 uF disc*	1 2N708
3 1.0 uF Mylar	
1 10 uF 16 V	
1 47 uF 16 V	
1 470 uF 16 V	

*May be needed if rf problems occur

NOTE: Negatives for photo-etching are available from the author for 50¢ each postpaid.

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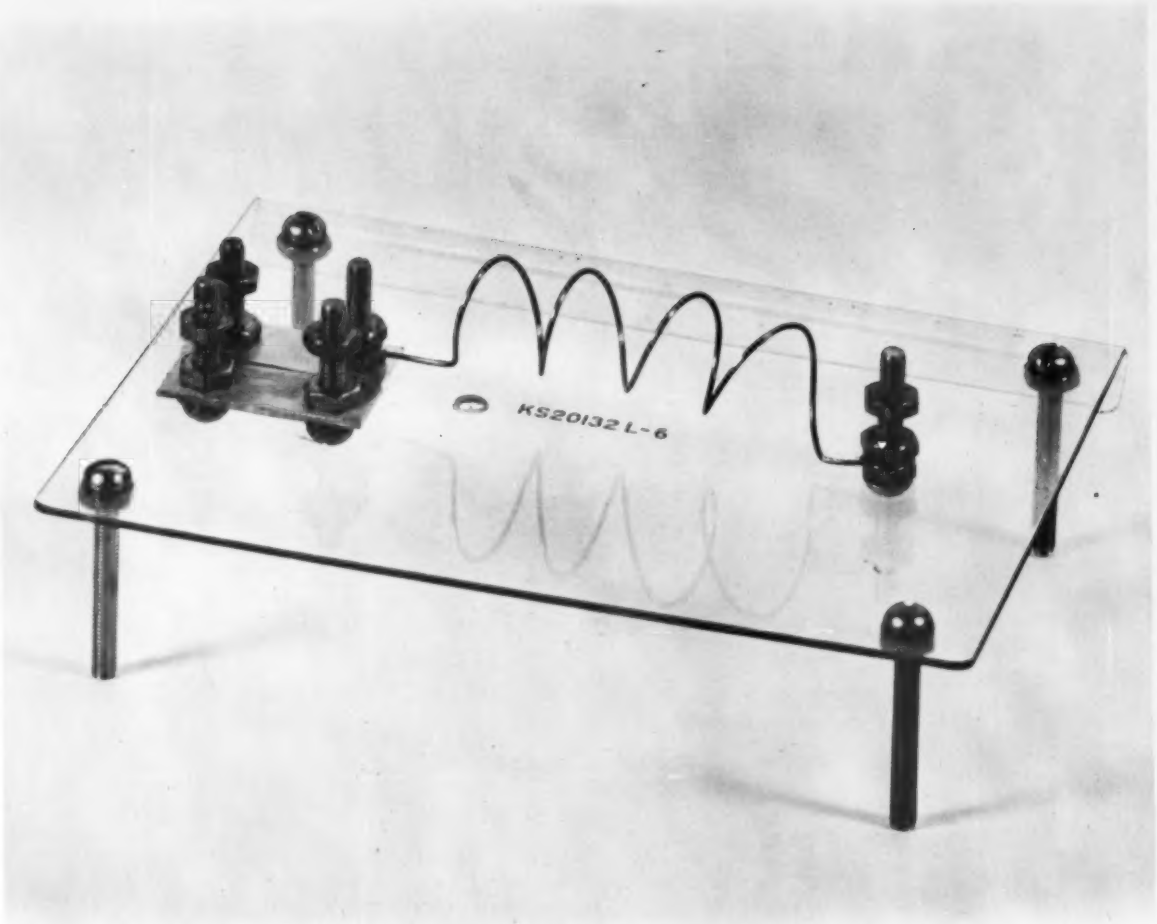
or call Area 404/971-HAMS day or night. See You There!!



Lightning and Thunder and Other Stuff

-- can J. Bach be a relative of P.D.Q. Bach?

J. K. Bach
Ivy Hill Road
Walden NY 12586

For help with this story, I am grateful to C. S. Daugherty, Teaneck NJ, Mr. and Mrs. Ashley, Walden NY, Barbara Gerard, Dale's Auto Parts, Walden NY, Shorty's Taxi Service, Walden, NY, E. Hassdenteufel, Telco, Newburgh NY, W. Green, Peterborough NH.

Over a hundred years ago, a father, mother and their two daughters sat before their fireplace, watching the dying embers. There came a bluish flickering in the chimney.

"What's that, Papa?" asked one of the girls.

"Wait a minute, and you'll see it again," he said.

Soon it came again, and took him with it when it went, without harming any of the others. One of the girls was my maternal grandmother, who was terrified of lightning all of her days.

Many don't know that heat ionizes air, and that a hot flue is a dangerously good conductor for lightning. An open window is not so good either — to stand in one during an electric storm is foolish bravado. A lightning stroke may be three miles long, *all of it* through air. It is well to avoid metal, but that does not, of itself, guarantee safety.

Many people get knocked kicking, or cold, by secondary or induced strokes. A lifelong friend of mine was in his house and saw a black walnut tree struck, and something knocked him down at the same time. With its bark blasted off, the tree later died. He also had a playmate who lagged behind a group and was struck in the open and killed.

Lightning deaths in this country run around four hundred a year, more or less. A thousand more are injured more or less seriously. I don't know if anyone has ever survived a direct main bolt of lightning — what they recovered from may have been secondary or induced shocks.

It often happens that a man's shoes will fly off when he is struck. Women's slippers are not very secure, but shoes, laced up, come off a lot harder. Lightning can do it, and frequently does. I think this is due to a violent muscle spasm.

If you like to investigate little understood subjects, try your own lightning investigation. In big cities, nobody knows what lightning is, except in the most general way; country and small town people have come to terms with it, and they can tell you stories . . . !

For instance, a close neighbor's wife saw a doorman struck from across a courtyard, and both his shoes flew off. He recovered quickly. Her husband's father, when he was seventeen, was struck and was unconscious for several hours. Thereafter, whenever an electric storm came up, he would lapse into deep unconsciousness, from which it was impossible to rouse him. At twenty-five, he married, and when his son was born, the baby used to drift off to sleep, or it may have been unconsciousness, along with his father. This was no catalepsy: They were both completely under. When the child was about eleven, he stayed awake. It is easy to think up explanations, but the passing years make it impossible to check. So nobody knows the answer, if there is one.

Another friend, who runs an auto supply business, saw a lightning flash at the very tail end of a storm which struck a locust tree. (These are frequent targets.) It spiraled the trunk more than once, jumped to a nut tree which was very close, down to a clothesline pulley and along the line, which was plastic with a steel center. Blankets were pinned to the line, and as she described it, the clothespins snapped off the line successively in a high arc like flights of arrows. The blankets fell. At the near end, the bolt burned out the telephone and its ground, knocked boards off the garage, set them afire, and simultaneously induced a power failure. She had to call the fire company, the telephone company, and the power company from a neighbor's phone and return to fight the fire.

What stuck in my mind was this one-at-a-time business with the clothespins, since I knew that lightning peaked out at 90,000 miles per second. So I asked about this again. She was less sure about the clothespins, but the ground was very muddy and held a film of oil and grease from parked cars. The blankets fell into this muck starting with the furthest one and continuing on down the line. If you have ever had a wash fall off a line — and I have — you believe her, science or no science. I never argue with facts.

At 90,000 miles/second propagation I defy you to see one end start before the other, but yet I have seen this many times and so have you and so have a multitude of people. Some of this is optical illusion — the strobe effect of ribbon or sheet lightning, perhaps. Some of it is imagination — you always see lightning strike *down*, even if it sometimes strikes *up*. In Fig. 1, next to the antenna, I have drawn a stroke of lightning as it was rendered in the middle of the last century. I don't know whether this was a convention, or whether it really looked this way to the artists of the day. Find an old woodcut of Franklin and his kite, and you'll see it shown that way. Not in real life though — no acute angles, no sawtooth. The fact remains that at times you *can* follow the progress of a stroke with the eye, and I don't care who says different. It is so, and I have seen it, and there was no mistake. The 90,000 miles/second is a *maximum*.

To continue, there was the local taximan. He was sitting in a dairy barn on a metal milking stool when the lightning rod on the barn was struck. He was knocked out, and when he came to, he saw a cow in a most un-cow-like position: flat on her belly with her front legs straight out in front of her, and her nose between her hooves. She recovered. Everything loose in the barn was upside down. Investigation revealed that the rod had been directly connected to the line of metal milking stanchions, which were embedded in the concrete floor-slab. The rod was properly grounded soon thereafter.

Some writer once pointed out that Franklin himself did not ground his lightning rods. The implication was that the old man wasn't very bright, which is a bit much. Old Ben is a hero of mine, and I happen to know that his first idea was to brush-discharge clouds and avoid lightning strokes altogether. But highly-charged clouds are swept along by the winds — the origin of sheet lightning, which strikes along a line that may be forty feet long. (This would give an apparent direction to the stroke even if it were near instantaneous.) There is no discharging such a cloud harmlessly except by a good lightning rod. Now Ben built an air shaft in his house, and suspended an iron lance in it (probably by strips of silk cloth, his favorite

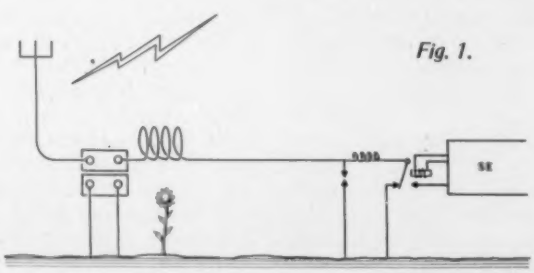
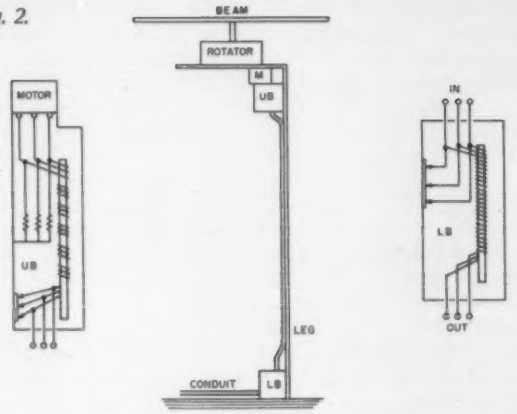


Fig. 1.

Fig. 2.



insulator) free from ground. His description makes no mention of any window, or viewing port, or peephole in this structure, but what do you think? I think he had a small window he could watch through from a rocking chair. I also think he could open this window, reach in, and charge a Leyden jar, or his own flat-plate capacitor, in fair weather from the normal voltage gradient whenever he felt like it. There is nothing in his writings to this effect, but it figures.

Franklin was no less interested in electrical discharges than any other scientist. Ask any of them. And ask them if they would attend a lecture by the old man if this were possible, and they might surprise you. As a scientist, then, he was studying discharges, and I infer that he got knocked off his chair one day and concluded that the brush-discharge theory applied only to Leyden jars. He grounded his rods forthwith. Earlier, he himself had written, "Experience keeps a dear school, but fools will learn in no other." He wasn't about to pay the tuition, himself.

Lightning comes and goes; it doesn't stick around to be studied. Aside from a few specialists, little is known about it. We not only don't know the answers, *we don't even know the questions!* When lightning strikes very close, say, within a hundred yards, there is no thunder. I have observed this myself. I also checked this with a hiker who was narrowly missed along a cliff path in the Poconos. What you get is one tremendous, ear-splitting CRACK, or explosion, and after that, nothing. No rumble, no echo, dead silence. Maybe your ears don't work very well afterward, but I have noticed the same thing with guns. Fire a thirty-oh-six or equivalent, and then listen to one across the valley and you will see what I mean. When you don't hear the rumbling thunder, you had a near miss and you had better believe it!

Sound travels at about 1100 feet per second. Five seconds between flash and thunder would indicate a mile and a little. Ten or fifteen seconds and the lightning is quite far away. But even at a mile, you sometimes get a sharp "click" simultaneously with the flash, followed by thunder later. Where does the click come from?

Obviously it comes from a pole transformer or lightning arrestor on a nearby highline, and you can hit one of them with a rock from anywhere. Nearly anywhere: Once I was really in the country, a storm came up, I got the flash/click with thunder following, and there went another perfectly good theory. I could see the nearest highline miles away.

During WW II when the 243-type air-spaced crystal holder was being developed, it was found that some plates would oscillate well in some holders and not at all in others. It was theorized that the defective holders had the wrong number of acoustic quarter-waves in them; they were redesigned, and were worse than before. After a lot of careful checking, it was determined that the sound waves had *twice their normal velocity* under the observed conditions. The formula was revised, the electrodes spaced accordingly and 243s were turned out like popcorn. So! *Two* different velocities for sound, eh? Let's call ordinary sound wave propagation O.S.W.P. and the more rapid mode, a *percussive* propagation. The O.S.W.P. takes advantage of the mass and the elasticity of the medium and is propagated very efficiently, but somewhat slowly. The percussive mode is explosive; it is driven outward from the source without regard to anything but its own force. It is not an efficient mode, since it is very rapid, and it is quickly attenuated. Does that fit the facts?

I saw an interesting submarine movie once. The boat was taking a real depth bombing. First a sharp "click," a wait, and then "Boom!" An officer explained to a passenger that the click was the detonator going off, followed by the boom of the main charge. You could tell if the explosion was near or far by the interval between the click and the boom. Sound familiar?

I have handled enough dynamite, and reloaded enough cartridges in my time to gag over the idea of an interval between detonator firing and the explosion of the main charge. Properly rationed, there is enough silliness here to supply a man for weeks. *There is no interval* between them, none that you could sense. The propagation speed of the explosion is what? — about a mile a second? — something like that, and all this stuff is together in one big drum. Having little faith in movies and their sound effects, I consulted a submarine expert I know — he has survived many depth charge attacks. He says no, it doesn't sound anything like in the movies, but yes, there is this click-pause-boom business, just as described. I haven't read anything about it, or talked about it to anyone, but again I infer that this is more of the same — O.S.W.P. and (percussive) P.P. with the percussive arriving first, but the ordinary sound wave following, and both starting at the same instant from the same source.

What's important about this? Maybe nothing. It could be important; I don't know, you don't know, neither does anyone else. But if it exists, someone should know about it. It is worth discussing.

The Encyclopedia Brittanica has a lot to say about lightning, and much of the information comes from the States, surprisingly enough. The Americana and the Collier's also have interesting sections. It is said that a lightning stroke has a diameter of 20 cm or about eight inches. What's wrong with that?

This: A flagpole is typically eight inches through. You can see the flag quite a distance, but the pole soon becomes invisible. You *know* that anything across the river is at least three miles away — still, lightning seen over there is no mere fiery thread — it has a most definite width, maybe a couple of yards across. This you can see.

Ever watch a searchlight beam on a foggy night? It goes up and is blunted like a finger, stops quite abruptly. Even as seen from the side, you get some of this effect. It

either way is the right way

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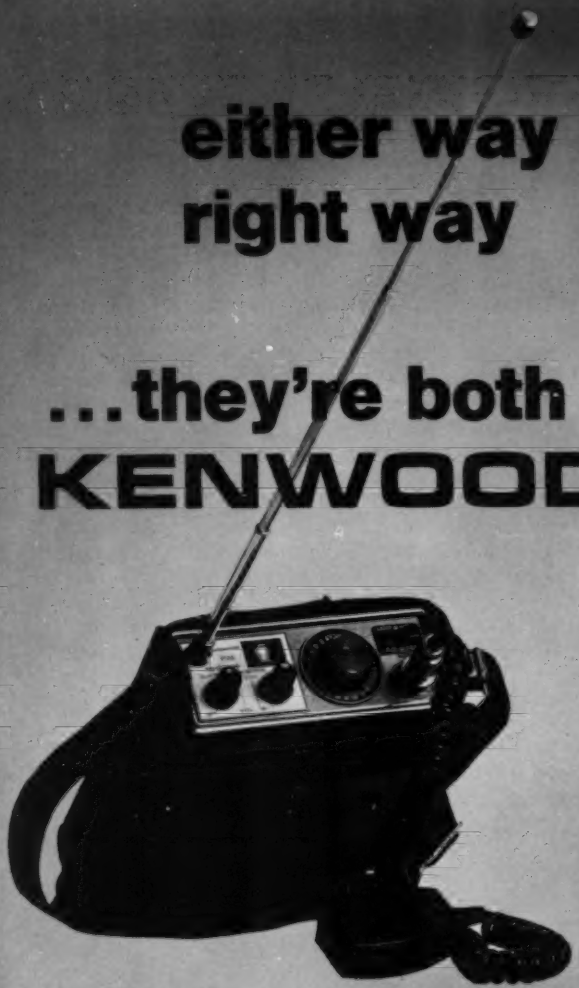

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should taper off gradually, but it doesn't. Maybe that is why lightning looks so wide?

No, I don't think so. The encyclopedias tell us that the temperature inside a bolt is a little higher than that of the sun's surface, and certainly its brightness approaches the sun's also. Then it should look several times fatter than it does with *that* much light, if the finger theory applies.

I picture lightning as twisting and squirming around in a six foot tunnel of near-vacuum and high temperature and glaring light. Maybe the individual bolts are only eight inches across, but they succeed each other at very short intervals and pretty well fill the tunnel before the bolt subsides.

But no one will ever look down such a tunnel and see what I have described. Airplanes are sometimes struck by lightning, usually without harm other than a small hole burned in the skin of the plane. Pilots have said that the first time was terrifying, and the second, worse.

Why worse? I dismissed the subject, as you probably have, until this writing. The answer undoubtedly lies in the fact that the glare is so bright that the pilots can see nothing for five minutes or more – not outside, not instruments. Turbulence prevents hands-off flying, and currents of several thousand Amperes can magnetize and burn out almost anything. I shouldn't think the autopilot or radios would work very well. But the main thing is that, from any altitude, a modern plane can get *below* ground level in less than any five minutes. I think I'd give up flying, if I survived the first bolt.

We ought to get something practical as well as educational out of all this. OK, lightning arrestors. They are very old, not so old as the lightning rod, but in wide use on power lines at the turn of the century. Simple gaps have been sold as "lightning arrestors" for radio receiving antennas for a half century, but a simple gap is only half an arrestor.

When I worked for Ma Bell, I worked with a New York Tel man who had been an installer. He had a lightning trouble to fix, so he went to the house, replaced the drop wire which was shredded, and then looked for the arrestor. Now this is a book-sized slab of glazed white porcelain, with two long skinny fuses on top, and a metal screw can, which covers two carbon gaps which are the main arrestor. It was supposed to have brass terminals on it, too. Apparently the bolt had made sand of the base and vaporized the metal, since there wasn't a single piece of the thing to be found – not a sliver the size of a fingernail. The subset inside was in perfect order – he made sure of this.

By the way, the Brittanica has a line drawing of this lightning protector together with a brief description. The output of the protector (arrestor) where it goes into the house has the wires bent into a "drip loop" which is the subject of much discussion among installers. Eddie, my friend, surmised that this loop, besides dripping water off, made up half a turn of inductance, which was somehow responsible for keeping lightning bolts out of houses.

I agreed with him without reservation. It is a very low inductance, some fraction of a microhenry. Lightning is pulse stuff which seems to have an equivalent frequency of at least a megacycle. At that frequency we shouldn't expect much inductive reactance, but wait – the wave front of lightning is an extremely steep one. We are used to thinking in terms of a square wave of a few volts on a CRO. End to end, a lightning stroke may approach a BILLION volts, and there is one hellacious difference between rising six volts in a microsecond and rising, say, twenty thousand or more. Now, it doesn't have to equal the lightning voltage very far, only until the gap breaks down. Once this is well ionized, you have a pretty good short circuit and the inductive reactance is unimportant.

So far as the ground path is concerned. But it amazes me how people forget that in order to work, the inductance *must* have some current in it. (Heck, they mostly even forget to include the inductance!) What does this mean? It means that 99 44/100% of the bolt goes straight to ground, while 56/100 of 1% makes burned toast out of the front end of your transceiver or whatever. You just HAVE to account for this 0.56% because it is 0.56% of a lightning bolt, and may be sizable.

What then? I show, in Fig. 1, another arrestor at the station equipment which is not actually installed, but should be. Backing that up is a relay which is energized as long as the equipment is turned on, cutting the end-fed antenna straight through, or grounding the antenna on its back contact when released. I don't have that installed either, but I'm going to have. I have seen receivers with the front end burned up and I don't want any.

I said that nearly everybody neglects the inductors. But look for them in Telco and Powerco installations. And Radio Broadcast Transmitters. I worked a couple of years for a local BC station. Their coax cables are as big as your wrist, and the "drip" loop, or inductor, is three turns or so, each a yard across. The end is connected across the base insulator, and in parallel with this is the lightning gap. It looks like a piece of heavy strap iron, grounded under the base insulator, with a bolt at the top that faces a tower leg, spaced no more than an eighth of an inch away from it.

One morning, as the FCC requires, I was reading the antenna base currents and logging them, when the lightning gap caught my eye. While it looked heavy enough to swing on, I was a little cautious – I reached out and tapped it gently with the edge of my shoe. Not like Kojak entering an apartment, but rather gingerly. I got a big, bright, hot arc that stood for five long seconds and went out. I loped back for the transmitter at my very best lope but everything was OK; the tape was still running and there were no telephone calls. Nobody listens! I concluded that the strap was several laminations of sheet copper painted black. I know it was flexible and not very springy.

Another man I worked with had a farm, and used fence "controllers" for cattle – i.e., an electric fence. Lightning got this thing every couple of weeks and he needed a new one, or extensive repairs. I mentioned the drip loop and he wound about ten turns at the controller terminal. No more trouble.

My own lightning arrestor is for an end fed 80 meter dipole. Most lead-ins are 50 Ohm transmission lines, but this poses no problem at all. Just wind the whole business, center conductor, braid and all, in a coil. It won't even add an irregularity to your line. Maybe a gap will, though there is a coax fitting with a built-in adjustable gap that is supposed to be OK.

But how about transmitting through such a device? Wouldn't it need a gargantuan gap? Let's see ... for a 50 W line at 2 kW Peak Envelope,

$$P = E^2/R$$
$$E^2 = PR = 2 \times 50 = 100$$
$$E = \sqrt{100} = 10$$

which I don't believe for a moment and I hope you

don't either. Obviously I'm suffering from a lack of coffee.

Ah! Much better!

$E^2 = 2{,}000$ (ah-HAH!) X 50
$= 100{,}000$

$E = \sqrt{100{,}000} = 316$ volts

or some such, which is a lot more reasonable. I have heard the figure 8,000 volts breakdown between needle points. Spark plug gaps are a great deal shorter than this, but remember they work under high pressures. So it looks like the little fitting I spoke of will work for a full sized ham transmitter. If it doesn't, and you have to introduce a larger one, which makes an irregularity, remember please, that lightning makes lots bigger ones.

Fig. 2 is about rotators and their wiring. I don't have one of these, but if I did, I should protect it as shown. The box does not have to be steel, but steel is nice. When lightning goes down that leg to ground, there is an enormous magnetic field produced. There is no way to shield the wiring – all you can do is "drip loop" and gap it. At the motor end, I have shown some resistors to ground. These are high enough not to affect normal operation, but at the same time afford a lightning path to ground besides that of the motor insulation. I have a feeling that the windings will break down pretty easily unless there is protection. As I say, I don't own one, so this is all theory.

We don't know the whole story about lightning yet. As a child I lived across the river from Cincinnati. One evening I was treated to a celestial fireworks display like no other I have seen or heard of. So far as I could see, there was not a cloud in the sky. The arc in the lone streetlight in our block sputtered and clinked, but the lightning outshone it making it negligible. Starting at the southern horizon, the bolts crawled across the sky to the zenith, like the fiery hands of God reaching . . . reaching . . . for whom? For a frightened little boy (me), guilt-ridden as all of us then were? Not to feel guilt continually was surely arrogance, which was something else to be guilty of. Nevertheless, I watched as long as I dared, because there was no slightest sound, save the beating of my own heart and the clinking of the arc light. The lightning was completely silent, and as spooky as anything Hitchcock ever dreamed up.

I asked my parents about it. "Heat lightning," they explained. It was so far away that I did not hear the thunder it generated. Far away? Straight up? And if you look up definitions you will find exactly that explanation in modern books.

In 1885 the Washington Monument was struck several times on one occasion, and several observers testified that the strokes were absolutely noiseless. The Empire State Building often has noiseless strokes. Here it is theorized that the upward "stepped leader" was not followed by a main stroke (they don't say why) so that the violent blast is missing.

The Brittanica also mentions that a length of #14 AWG rubber-covered wire was struck by a bolt, which in some fashion completely removed the wire, leaving a tube of rubber intact. They don't say how long the wire was.

Apparently someone had doubts about all this, so he set up an experiment with the same kind of wire (Dammit, how *long* was the wire? It makes a difference!) with exactly the same results – the artificial lightning either vaporized or melted or punched out the wire insert leaving a rubber tube, intact.

I have succeeded with this story if I have convinced you only that *lightning is nothing to horse around with!* ■

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The May 1975 issue of *73 Magazine* contained the article "Fat Nixies For Chronometer Nuts." I'd tip my hat, if I wore one, to anyone who makes use of a surplus bargain, and the Burroughs 7971 alphanumeric tubes are a steal on the market at the present time. When used as the display for a six digit clock, they become an eye-popping conversation piece.

Having accumulated a sizable stock of the giant nixies with clocks in mind, the *73* article was a welcome sight and inspired me to get out the old soldering iron and dust off the workbench (that is if you can call four layers of assorted junk, including, but not limited to, resistors, condensers, wire, metal drill shavings, transformer laminations, etc., "dust").

My giant nixies were acquired complete with the sockets and brackets mounted on boards. Each assembly includes two nixies, two sockets, 33 transistors, about 100 resistors, 25 diodes and 18 capacitors, plus wire.

Before I began work I reached for the Radio Shack catalog to look up the price I would have to pay for the RS2008 300 volt NPN transistors specified in the article. It quickly became apparent that the $5.00 paid for the three boards (with six nixies and sockets) was only a small down payment on the finished product. Another bottleneck (at least to me) was that a quick look through the latest flyers in the shack showed no readily available source of PNP 300 volt transistors at any price. (I never did get around to writing Heathkit.)

Since I had ordered nixies to build seven of the clocks for use as gifts (for people

who seem to have everything), I was somewhat reluctant to purchase the necessary 448 resistors and 175 transistors, when half or more of the little solid state devices would be costing upwards of $1.50 each. Besides that (now we get to the nitty-gritty), the pocketbook was slightly flat!

So I kept staring at those surplus boards with those 33 transistors in nice shining rows, and all those other parts. And I kept looking at the May 1975 issue of *73 Magazine* and at the spec sheets which came with the MM5314 clock chips. At one time, I reasoned, those same 33 transistors *had been used to drive the nixies.* So why not use them in the nixie clock?

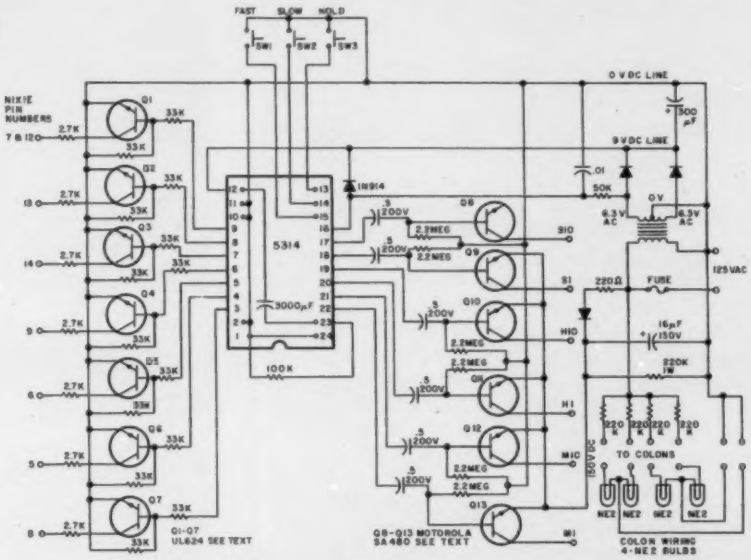


Fig. 1.

It was easy to determine that the long row of transistors farthest from the brackets had been used as segment drivers (UL624). Two transistors located at one end of the board, approximately two inches behind the only 2 Watt resistors, were determined to be PNP high voltage type. Most are Motorola SA480. A few boards used Texas Instruments, designated UL480.

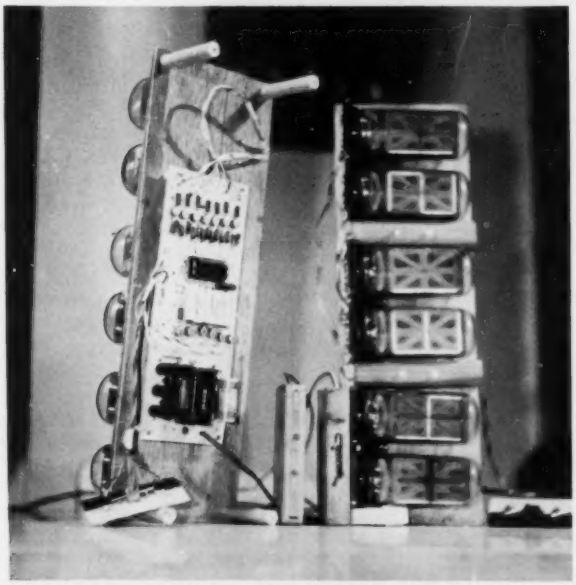
But I had no way of knowing how high the voltage rating was. I am sure many readers have access to books and could easily obtain the specs, but nothing I had gave the information, and inquiries among friends and on the nets failed. So I crossed and uncrossed fingers and began experimenting with the following objectives in mind:

1. Build a clock using as many parts as possible from the surplus boards.

2. Simplify the design and eliminate as many parts as possible.

I am happy to say both objectives were more successful than I dared hope. All transistors were taken from the boards, as were a large number of resistors. Even the board itself, with PC strips removed by sanding, is used as the "board chassis."

The total number of parts has been cut approximately in half, resulting in substantial savings even if the nixies are bought less boards and it is necessary to purchase transistors. As examples, my clocks use only 13 transistors rather than 25 as specified in the *73* article, only 27 resistors in circuits associated with the driver transistors compared to 64, and the power supply has a total of 3 diodes instead of 8 and 2 resistors rather than 4. At the same time, sharpness, clarity and brilliance of the numerals leave nothing to be desired.



Two clocks, ready for cabinet, standing on end. A pair of colon blocks, viewed from the front and rear, stand between the clocks.

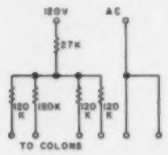
The construction of the clock is straightforward and not difficult. It actually is built in three phases or parts, which are then brought together for the finished project: the display, the brain-board, and the cabinet.

A cabinet may be built of any material for wall mounting or for table or rack. A good grade of full one inch oak, birch, walnut or maple, etc., will make a cabinet worthy of the "works" you will build. My choice was wall clocks of wood. Once this decision was made the rest of the construction fell into place.

Since the cabinets were to be of wood, it was natural to mount the nixie socket-brackets on wood. For this purpose cut a piece of plywood or ¾" plank 16½" long x 5¾" high.

The brackets are removed from the PC boards, leaving the sockets intact, and sawed off just toward the center from the mounting holes. The two bracket ends containing the sockets may now be bolted together using the existing hole. The three boards will yield three pairs of bracket-sockets, for hours, minutes and seconds.

Fig. 2. Alternate colon wiring, enabling use of resistors from boards.

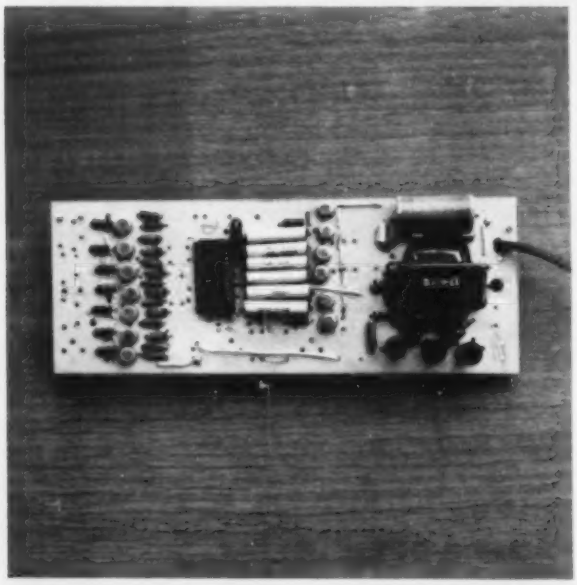


Mount with short wood screws along the bottom of the wood strip, leaving approximately one inch between pairs. (Colons will be placed in these gaps.)

You are now ready for some wiring fun – multiplexing the segment pins. This simply means connecting all like pins together. Wire only the pins used, of course. (See page 24 of the May 1975 issue of *73 Magazine* for details.) The wires should be formed to run along the back of the sockets along the bottom edge of the wood. Use seven color coded wires; a cable is formed approximately one foot long which is passed through a ¼" hole to the back of the wooden board. Six wires, also color coded, are wired to pin 13 of each nixie and are also brought to the rear of the plank.

Two colons are made from four NE2 neon bulbs. The NE2s are mounted in shallow ¼" holes drilled in two wooden blocks which hold the lights approximately even with the surface of the giant nixie display. With a small bit, drill two separate holes from the bottom of each shallow hole through to the back, for the NE2 leads. A ¼" hole is drilled from the bottom end of each block near the back and allowed to "come out" the back midway up. In this manner the leads of the NE2s may be reached and connections made. Three wires are brought out the bottom (one common and one to each bulb). This wiring is cabled with the segment wiring and also brought to the back of the display board.

The NE2s are fed from the 120 volt ac line through four 220k resistors, which gives the proper brightness to match the display.



Top view of board. Transformer is mounted with half below the board. The three black spots below the transformer are three 100 uF filters, 25 V rating, paralleled. Segment drivers are at one end of the board. Digit enable is near the center.

Bottom view of board. Resistor above the transformer is the H. V. bleeder.

If it is desired to use parts from the board, four 120k resistors may be used, one to feed each NE2, and one 27k resistor to feed the four resistors. See alternate colon wiring.

With the display complete you are ready to tackle the "brain-board." There is no question that a printed circuit board would be the ideal way to wire the clock. But not having PC facilities and desiring to build only seven clocks, it seemed sensible to proceed with freehand layout and drilling. Actually I use old PC boards with the strips sanded off with a rotary sander.

The power supply should be wired first. A 12 volt center tap filament transformer allows use of only two diodes. However, a 6.3 volt transformer with a bridge does an equally good job. You should come out with approximately 9 volts dc for the clock chip. At this voltage the chip does not run even slightly warm and operates perfectly.

Experiments showed the giant nixies fire with a voltage much lower than the 180-200 volts. Using a lower voltage gives a safety margin for the high voltage transistors.

In the interests of cost and simplicity, a simple half wave circuit is used to rectify the line voltage for the 150 volt supply. A 16 mF capacitor with at least 150 volt rating is sufficient filtering. A 220k 1 Watt resistor serves to bleed off the voltage slowly when the clock is unplugged.

Writing this, I can almost hear the screams: "A line voltage rectifier! A hot chassis!"

Well, this clock has *no hot chassis*, because it has no (metal) chassis. Note in the diagram there are no ground symbols. Only a "0" volts dc line. This same line has one leg of the 120 V ac on it. But, kept completely under the board and enclosed in a wooden cabinet, it certainly does not present a shock hazard.

Once the power supply is complete and tested, the clock chip socket should be mounted in the approximate center of the remaining board space. Then mount the components, and wire everything

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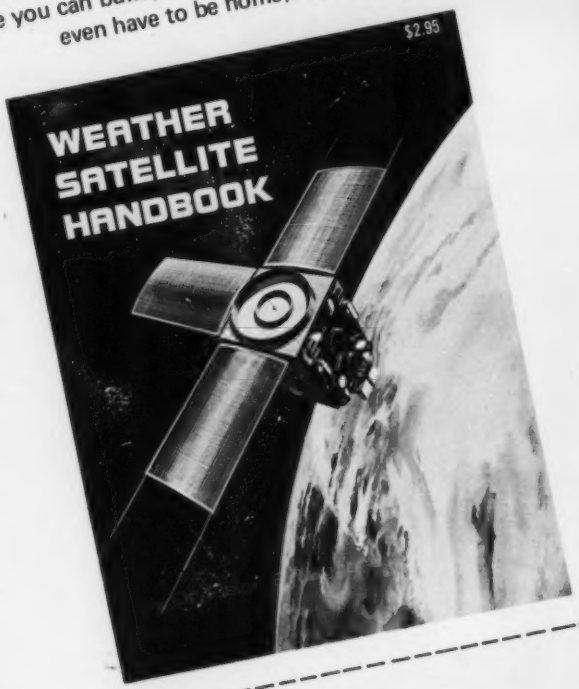

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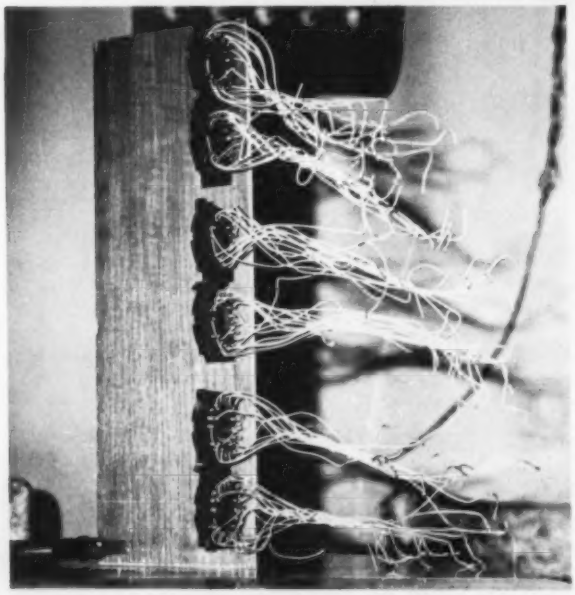
The bracket mounting, wiring, and colon mounting.

associated with pins 2, 10, 11, 12, 16, 23 and 24 of the chip. At this point, if you wish, you may install the chip and apply power.

Using a scope, if all is well, you should see pulses appearing on pins 17 through 22. If you do not have a scope, a VOM may be used and you will get a pulsing, variable reading on the 12 V scale from pins 3 through 9.

The segment drivers use the UL624 transistors from the surplus boards. I have never had one fail, even while experimenting. Only six of the 33k resistors are available from the boards. However, I have used 20k resistors from the base of the transistors to the IC chip with no noticeable change in operation of the clock. So this does not appear to be critical. Because of the much lower voltage and shorter duration of the pulses, 2.7k resistors are used for current limiting – all from the surplus boards.



Tube sockets and brackets after removal from surplus boards and mounted on wood strip. Wires are left attached and used for multiplex wiring.

The tricky part of the giant nixie clock, as mentioned in the May 1975 article, is interfacing the digit enable pulses with the high voltage transistors. It is, of course, an absolute must to keep the high voltage isolated from the low voltage chip, while at the same time passing a pulse of sufficient intensity to trigger the transistor and provide the voltage to light the proper segments of the nixies.

Fortunately such a device to do this is in existence! It was invented quite a number of years ago. This needed device is called a capacitor.

My first effort was to use the .022 condensers on the surplus boards between the chips and base of the high voltage transistors. If one turned the lights out in the shack, flickering numbers could be seen.

An 8 mF filter, + side to the base of the transistor and connected across one of the .022 capacitors, lighted a numeral brightly. But six 150 volt filters would not be exactly cheap or space saving. And the numeral had a tendency to pulse.

Any old-timer and most new hams know it takes a very large capacity to pass a low frequency, while a very small capacitor will pass a high frequency.

So, why not raise the multiple, or scanning rate, thereby increasing the frequency and shortening the duration of the pulses? Hence the 3,000 mmF condenser in the frequency determining portion of the chip circuit. With this scanning rate, .5 capacitors pass the pulse nicely. With this problem solved, building a clock became a matter of mounting parts and wiring.

One word of caution: Be sure and short the leads of each .5 condenser together before installing to be sure there is no residual charge. A capacitor holding a charge, if connected to the chip, can knock out the device.

When first firing up the clock, you may feel something is wrong as not all numerals will necessarily light. For some reason the first digit usually comes up a "3," and the other numbers will probably not make sense. But the seconds should be counting. Press the fast forward button and run the clock through a full 12 hours. If all is well, it will straighten out and the sequence will fall into place.

Building the Cabinet

For those who may wish to duplicate the wall clock, I will give the cabinet dimensions. Whatever type cabinet you decide on, the inside space will have to be large enough to accommodate the 16½" length and approximate 6" height and 5" to 6" depth.

My cabinets are built from 1" wood and overall dimensions are 24" high, 18½" wide and 8" deep. The top of the clock forms one shelf and is 7" deep. The bottom shelf is 3" deep. The wood is finished only with Formby's Tung Oil and hand rubbed – no varnish.

There is no special grooving. Only two side panels, shelves and back, cut to fit and put together with dowel pins – no nails. A piece of glass is placed in front of the nixies, as are two 2" wide pieces of trim, reducing the opening to approximately 4 inches.

The cabinets are cut out entirely with a circular and a saber saw and finished with a sander. The only special work

is rounded corners and a groove for the glass, courtesy of a neighbor's router.

So-o-o, if you haven't already taken the plunge and built a really glamorous digital clock, why not? You'll have fun and the clock in the house (not the shack) is guaranteed to earn you plenty of brownie points with the XYL. She just might decide all that electronics knowledge you've been soaking up is worth something after all! ■

For those who may purchase the nixie tubes less boards, or have bad PNP high voltage transistors on a board, a source of a high voltage PNP transistor is RGS Electronics, 3650 Charles St., Suite K, Santa Clara CA 95050. The designation of this transistor is "P-8," the voltage rating 150 V. I have used this transistor completely in one clock and the results were perfect. The numerals were somewhat brighter. It was necessary to increase the capacity of the frequency control condenser when using this transistor. Cost of the "P-8": 30 cents each.

RGS also has several NPN transistors suitable for segment switching.

I have been substituting quite freely the resistors which are connected to pins 3, 4, 5, 6, 7, 8 and 9. Values as low as 15,000 Ohms work very well. The boards have a large number of these resistors on them. Also, the 33k resistors to ground (from the bases of Q1-7), are not critical. In general these resistors should be of higher value when substituting, while the resistors between base and IC should be substituted at a lower value. Of course, all substituted resistors (either string) should be of the same value, i.e., all 15,000, etc.

I have completed five additional clocks since writing the article.

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Creative SSTV Programming

--how to put pizzazz into your show

Ralph E. Taggart WB8DQT
4515 Oakwood Drive
Okemos MI 48864

Slow scan television can, without a doubt, add the single largest new dimension to amateur radio activities since we started using phone. Unfortunately, the way in which most of us have used this new mode is far from creative. The advent of new operating conveniences such as keyboards has not improved matters; in fact, many "video" exchanges have degenerated into nothing more than typed exchanges which could be accomplished just as easily with RTTY. The goal of SSTV operation is to add a visual dimension to a QSO, and if the miracle of picture transmission fails to add anything new to the "rituals" we perform on the air, we have achieved little beyond acquiring a rather expensive novelty. There are a few creative SSTV operators around – you can recognize them because their exchanges are lively and interesting without having to resort to magazine centerfolds to keep your attention. Such a level of operating does not come about simply by acquiring gear – it takes considerable time and attention and some practice to develop operating and programming techniques that will raise you above the teeming crowds. The purpose of this article is to acquaint both new and seasoned SSTV operators with some of the ideas and techniques that will help make your pictures worth watching. Let's look at some of these and see which might be applicable to your situation.

The first area to consider is programming – what do you want to show? If the name of the game is working DX or simply seeing how many stations you can work, then it hardly pays to spend good money on a camera. Simply get a keyboard and start typing. Your countries total will mount but the QSOs will be as sterile as the typical impersonal exchange that marks so much amateur operation these days. Of course you will want a selection of ID slides and test patterns for calling CQ, 73 and all that jazz. We can also throw in ourselves, but few of us are good looking enough to keep up interest with that sort of material! There is, of course, all that gear that you have so lovingly assembled, but let's face it – my SB-102 looks very much like yours. Even if you have a piece of gear that I don't, it is

probable that I already know what it looks like, otherwise the advertisers are wasting a fortune in promotion! Your shack – the way you have piled all the junk together – is probably unique and a picture of this can substitute for a visit. Unfortunately, the roster of material in most stations runs only this far. This may thrill you to death if you are new at the TV game, but the prospect of facing nothing but such material on a Saturday afternoon when you have been in the game for a number of years is enough to make you leave the rig off and socialize with the wife and kids.

What about the wife and kids? They rank high on my list of subjects simply because they acquaint people with the family – just use them in moderation remembering the family movie syndrome. Are there other horizons? What are your interests? Are there non-obscene topics that turn you on? A photographic tour of the points of interest in your area adds a personal touch. Subjects such as a new model plane or anything from your other hobbies also brings you a little closer to the op at the other end. How about pictures from the last vacation or telling a story with pictures? The chances are the guy at the other end is used to watching endless streams of video trash; provide him with an interesting program, and at least you'll get a star in the log and maybe a friend for life! There are some people who are too busy to watch an interesting presentation. If you happen to get one of these, simply slip him your ID or type his call letters, maybe jazzed up with your leering face. He'll go away happy and the best part is that the QSO won't take much time! You can't get lessons in creativity, but look around you with the idea of saying something with pictures that you couldn't get across on phone. If you start thinking that way you will be on the right track.

A second major factor in SSTV operating is the way you use your equipment. There are several aspects to this area, some aesthetic and some technical. The technical part is easy – make sure your pictures have adequate video "swing" or contrast. There are many ways to insure this, including the WØLMD spectrum analyzer (*73 SSTV Handbook*), my own approach to budget signal analysis (*73*, January 1975), and some monitors such as the Robot and Venus which now come with spectrum analysis capability. Even pedestrian pictures look better when the camera is properly adjusted to provide a good video swing. The aesthetic part of programming concerns goodies such as lighting, camera angles, sequencing of video sources, etc. Let's look at some of these.

One of the most apparent shortcomings in most SSTV operations is the matter of lighting. The most common practice is to mount a floodlamp over the camera pointing in the general direction of the operator and hope for the best. In a typical larger room or one with dark walls, the result is a pale face floating in a sea of black – far more suitable for halloween than an exchange of pleasantries. Unless it can't be avoided, never use a single light source for primary illumination of the subject – the result will be harsh and far from pleasing. A simple light bar mounted above the camera and having at least two floodlamps is the minimum light installation you should consider. If the room has a light-colored ceiling, try "bounce lighting" – directing one or more lights at an angle toward the ceiling to provide more even illumination. If the camera can be arranged to view you against a close wall or the gear – fine – but if there is considerable distance to the nearest light surface, the background will appear black. A neat solution to this problem which I saw at W7FEN's installation was to mount a light-colored window shade on the ceiling behind the operator (as viewed from the camera). When you want to transmit live pictures, simply pull down the shade to provide a lighter background. The shade can be left up and out of the way when not in use. If the shade will be quite close to you, it should be grey, beige, or a distinct off-white color to prevent saturation of the background. If it will be located slightly further back from your normal seated position, it can be white to compensate for the additional distance. Here's another hint that as far as I know also originated with W7FEN. Control the intensity of your lights with a light dimmer or motor control. This will eliminate the need to get up and fuss with the camera f-stop; you simply dial in the light intensity required for good picture rendition. Camera and lighting angles are important as well. Profile views of the operator are generally not as pleasant as full face views – as much as people might admire your chin they still like to meet you face to face. Ideally the camera angle should be just slightly oblique along with the lights to emphasize facial contours. If strong shadows exist, fill them in with supplementary lights; light shadowing is pleasant to view, but you don't want your face to look like a lunar sunrise with extremes of light and shadow. Try to set up the camera position so that it is equivalent to someone sitting in the shack; avoid extreme camera angles. No one likes a view that looks like it originated from the ceiling, while a view of your face from the vicinity of your navel is equally unsatisfactory.

There should be less trouble with pictures of equipment and other features of the shack, for you can make these at your leisure and put them on tape for later replay. Use good camera angles and arrange lighting to avoid extremes of light and shadow. Hauling a camera around the shack during a QSO as a sort of guided tour is to be avoided like the plague. First of all, you rarely make coherent conversation as you are lugging everything around; secondly and perhaps more important, the pictures you produce this way are likely to be poorly lighted and composed. It is much easier to do it right and commit the pictures to tape, using them again when required.

For general operation, cassettes are probably the most flexible program medium. If you have a good recorder with an accurate editing counter, you can put several programs on a cassette keying up the program where required. If your tape counter is not accurate, you are better off using small cassettes (15 or 30 minutes) with a single program per side so that you only need start at the beginning of each side to have the program properly cued. The mumbling and fumbling that accompanies an attempt to find a certain set of pictures in a non-edited or poorly controlled tape will send the fellow at the other end looking for a cup of coffee or something stronger, particularly if he has heard this scene a hundred times before. Using tape, the station with a single camera can prepare innumerable programs while keeping the camera in position for live pickup during actual operations. If more than one video source is available – multiple cameras, keyboard, or flying spot scanner – the oppor-

tunities for creative programming are increased to the extent that all these sources can be utilized together in a coherent manner.

Many operators are also amateur photographers and maintain collections of 35mm slides that represent excellent potential program material. It is usually not feasible to set up the projector to work against a small screen and use the camera to pick up the picture. Either the projector or camera must usually be at an angle to the screen resulting in undesirable keystoning or foreshortening of parts of the picture. Even if the space is available to use a larger screen at a greater distance, the intensity of the projected image drops off. The solution is to use a rear projection system. A wooden frame between 1 and 2 feet square is used to support a piece of transluscent plastic. The projector is placed behind the screen with the camera set up on the other side. You can set up your slides in the proper order and use the slide changer mechanism to switch the slides between SSTV frames. This technique can be used with tape and a single camera or it can be used with a second camera while you are actually on the air. You should put the slides in backwards so they will have the proper orientation when viewed by the camera. If you have a keyboard, one of the most useful things you can do with it is to type "label frames" to be inserted between pictures to provide additional explanation of the visual material. WØLMD has designed a nifty titler circuit that will put a one line title in the actual picture frame. The letters are rather small, which makes them difficult to read under noisy conditions, but it does eliminate the need to interrupt the picture sequence.

The flying spot scanner is also a useful tool for handling routine picture material either as slides or photographs. Several designs are presented in the *SSTV Handbook*. An FSS can handle CQ and ID slides, your cartoons, and any photos you might wish to transmit while leaving the camera free for live pickup.

The key to good programming is to have a smooth flow of material. Pictures should be changed during the frame transition to avoid erratic display and poor continuity. If your picture handling mode doesn't permit such rapid changes, consider putting that particular sequence on tape so the recorder can do the job of stopping one picture at the end of the frame and starting another right before the arrival of a vertical sync pulse. It takes some practice, but you can produce excellent tapes without having to cut and paste. Usually five frames of a given subject is the upper limit. Three frames is probably optimum. Longer programs should be reserved for excellent band conditions where with proper editing technique you could probably drop to two frames per subject, thus saving 8 seconds. Remember that the fellow at the other end will be looking at a 120 line picture, so choose your subjects accordingly. Obscure pictures, such as the backside of a sleeping cockroach, may be excellent for those engaging "guess what it is" games, but are unsatisfactory for general programming. The macro-focus freaks are fond of showing extreme closeups of things like ICs and postage stamps. While such manipulations work very well to demonstrate the equipment, they can be so-so in the interest department. I don't want to disparage stamps in general; it's just that most of us have seen the common garden varieties. If you have a collection of rare or beautiful stamps, by all means use them. A note here: If you want to use macro-focus to maximum advantage, use the camera in conjunction with a suitable fast scan monitor. Poorly focused pictures are to be avoided, and this problem is more prevalent when you start playing the macro-focus game.

A final note in regard to multiple camera sources. Why not use a common sync generator for all sources — camera, FSS, and keyboard — to eliminate wasted time in switching from one source to another? Many FSS units and most keyboards are home brew. Why not take the sync signals from your commercial camera and use these to control the other video sources? Broadcast stations stay in sync by using a common sync source for all video sources, and you can do the same. This sort of thing is optional, but it does add a nice touch. Those of you out there who like to tinker with the gear might consider the possibility.

The key to a high class operation is to choose interesting pictures and handle them with the maximum versatility and technical expertise that your equipment permits. Putting together a quality video operation is not only a challenge — it will mean that other operators will want to work you as often as possible and perhaps pick up some hints for their own stations. We are only just beginning to learn to use this new dimension and many new techniques will emerge as we work on the subject. At any stage, however, there is no more excuse for sloppy picture technique then there is for a sloppy fist or ham-handed phone operation. That kind of operating will always be with us, but let's see if it can stay in the background as SSTV forges ahead! ■

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Don't Build This Project

--watch for my next...

James F. Reid W8LWS
4 Lawn Street
Ashley OH 43003

When I first got this brainstorm I thought I would earn a place in hamdom for building the world's smallest field strength meter. It may not be the smallest but it ought to win an award for something. Like many other projects that should have suffered an early death, this one started with a surplus of 35 mm film cans and the question "What if ... ?" I might also add that this project started with a deficiency of thought. The meter is a tuning meter offered in many hobby catalogs and said to have "hundreds of uses." Residence in a 35 mm film can is not one of these uses. If you should be so foolish as to buy one of these meters you will probably find that it has an internal shunt resistor which will reduce its sensitivity for this use. This calls for a little creative destruction. Using a drill bit held in your hand, carefully drill a small hole near one end of the resistor. Then, using a small instrument (a crochet hook works well), carefully break the wire going to the resistor. The next step is probably to go out and buy another meter and try again – or give up right now. In case you were lucky and have finally modified the meter, seal the hole with model airplane glue. Cut a hole in the bottom of the film can to fit the meter (lots of luck). The film cans are made of plastic and are very soft. Start the opening with a carefully drilled hole and finish it off with a pen knife. Have plenty of film cans on hand before you start this, and run cold water over your head after every third try. If you have gotten this far you will realize that the only way to secure the meter in the can is to glue it there. Don't glue it yet! You still have a good deal of teeth gnashing before you're ready to tie things down.

The next step involves finding a small pot to fit in the can. Don't try to buy a new one. They're very expensive. Take the film can and the meter to the nearest surplus house and find one that will fit without pounding. Spend at least an hour deciding just where you are going to drill the hole for the pot. If you have committed a single sin within the past fifty years the hole will end up in the wrong place and you won't be able to get the meter and the pot in the can together. If by some miracle you have gotten this far, glue the meter and mount the pot.

You will notice that I have a vertical antenna on the back of the unit. This was, perhaps, the easiest part. Mount a female phono connector in the cap of the film can (it's easier if you take the cap off first). The antenna proper is a piece of coat hanger wire. Make a small right angle bend in the bottom of the wire and solder it to a male phono connector. As most do-it-yourselfers will tell you, you cannot solder to a steel wire, such as a coat hanger, without first invoking several deities. In my case I scraped the wire clean and then used acid core solder (horrors!). If you are fastidious you can wash the acid residue off with soap and water. Now beg, borrow or steal the teeny-weeniest parts you can find to complete the circuit. Carefully plan parts placement and the order of soldering so things will fit (how's that for a cop-out?). The only thing yet to construct is the wire feet, which were made out of the same coat hanger wire (see Fig. 1). Do not try to use the film can as a bending form for the circle of the wire feet. A flashlight battery works fine for this and is much sturdier than the film can.

This field strength meter sits on my desk and is noticed and commented on by practically no one. The only comment it ever got was from a female visitor who said she thought it was "cute."

Don't build this unit. Have a cold beer instead. Watch for my next project ... an electronic whoopee cushion. ■

Fig. 1. Feet.

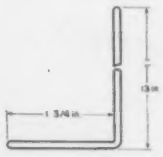


Fig. 2. Antenna.

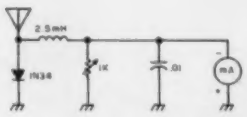


Fig. 3. Circuit diagram.

Hank Olson W6GXN
P.O. Box 339
Menlo Park CA 94025

CW Regenerator/Processor

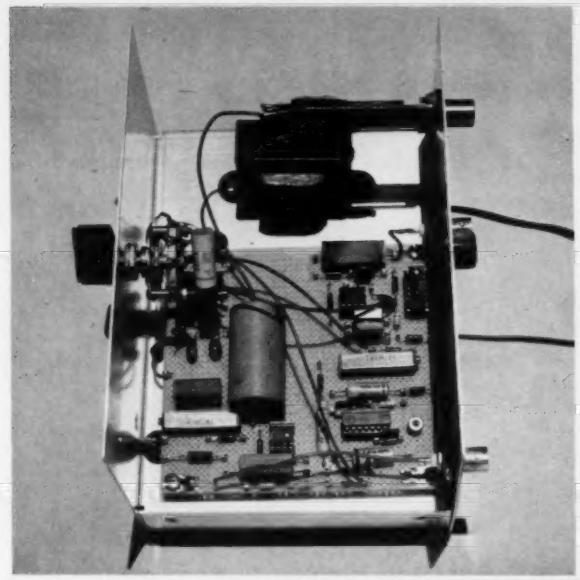
--also has TTL output for digital work

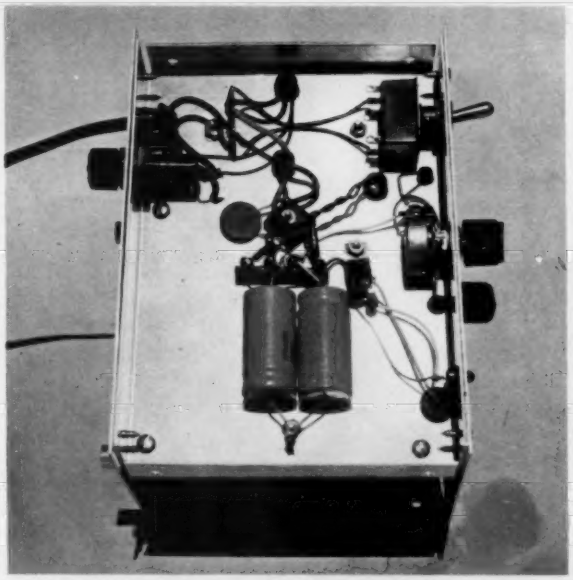
In an article in 1964, W6OI described a device called the "Paine Killer," which was designed to create a clean tone output from a relatively noisy CW signal from the audio output of a communications receiver.[1] The circuit utilized tubes and a relay, as did most such equipment of the day. Correspondence with the author indicated that he had every intention of redoing the Paine Killer using semiconductors; he may have done so, but it never came to my attention. My own plans to build a more modern version of W6OI's circuit were shelved in the "must get back to that some day" category.

A new application brought the whole idea back to life; a fellow ham wanted to build an automatic Morse code printer and needed a device to turn the noisy CW output of a receiver into TTL "ones" and "zeros." This had been done before in reference 2 by a circuit composed of five discrete transistors and 3 diodes, but the circuit didn't allow as much flexibility as I desired for experimentation. By using op amps and carefully separating functions, the IC circuit of Fig. 1 evolved.

Note, in Fig. 1, that in each of the three op amps we have the option of using voltage gain or not, as we choose. The first op amp, around which is built the "clipper," is operated at a gain of XII. When the *peak* audio input voltage exceeds about 0.45 volts, the output of U1A (pin 3) is at 7 volts peak. Since the inverting input of U1A (pin 1) is a virtual ground, the output voltage is effectively across the two inputs of U1 (pins 2 and 3). Note that only pins 2 and 3 of U2 are used, because this inexpensive op amp is being used as a matched pair of 7 volt back-to-back zener diodes. When the output of U1A attempts to exceed about 7 volts peak (either plus or minus), U2 goes into zener breakdown, lowering the gain of the amplifier built around U1A (by effectively putting a resistance in parallel with the 10k negative feedback resistor), so the clipper prevents the output of U1A from ever exceeding a (±) voltage of roughly 7 volts.

U1B is the heart of an





active bandpass filter with unity voltage gain, centered at 800 Hz, with a Q of 4. The design of this active filter is beyond the scope of this article, but can be found in reference 3. The Q being 4, of course, means that the filter is 800 Hz/4 or 200 Hz wide at the -3 dB points, that is, where the voltage response is down to 0.707 of its maximum value.

Around U3 is built an injection locked oscillator. The oscillator is basically a phase shift type, with the gain set at a value lower than that which will sustain oscillation. Since the non-inverting input (pin 13) is not involved in the oscillator feedback circuit (except for the requirement of being grounded via some finite impedance), it may be used as a convenient input port for external oscillator injection. The trick here is to increase the gain of the oscillator (adjust the 500k trimpot) with *no* audio injection, until oscillation is sustained; this oscillation should be near 800 Hz. Slight adjustment of any of the three 0.01 uF capacitors in the RC feedback network can be used to put the oscillator "right on." The oscillator gain can then be decreased until oscillation stops. An 800 Hz input signal can then be applied, and the injection level pot increased until oscillation starts again. The oscillation should only persist when an 800 Hz signal is present at the input.

The output of the injection locked oscillator is rectified by D1. The detector load time constant of this diode detector is approximately 5 milliseconds, which is a short enough time constant to allow reception of virtually all Morse code speeds. The dc level across part of the detector load is fed to U4, an LM311 voltage comparator. When the dc at pin 3 of U4 is more positive than that on pin 2, the output (pin 7) is "low." Since the voltage on pin 2 is set by the "voltage trip level" pot at (say) 1 volt, a zero dc voltage at pin 3 causes the LM311 output to go "high." A 10k resistor from pin 7 to pin 2 provides hysteresis and noise immunity to the comparator. The LM311 is capable of

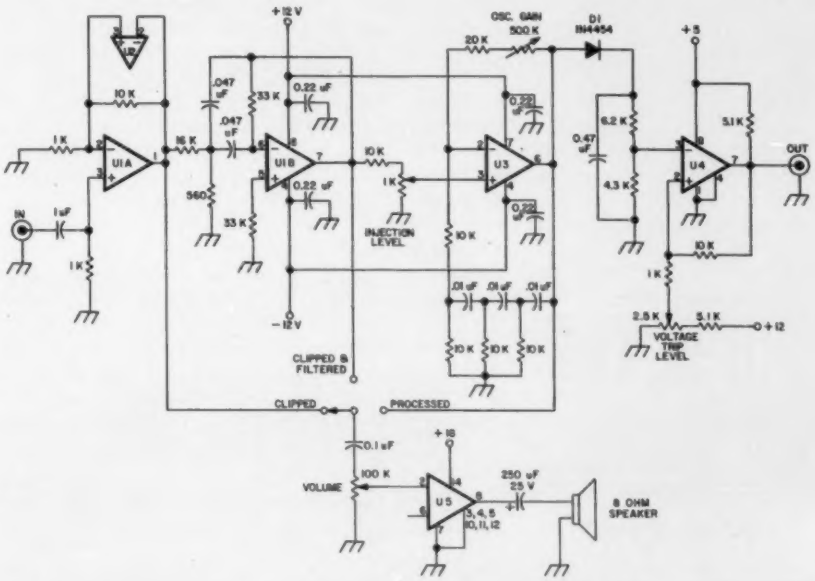


Fig. 1. D1 – 1N4454 or 1N914; U1 – National LM1458N or Motorola MC1458P; U2 – National LM709CN or Motorola HEP-C6103P; U3 – National LM741CN or Motorola HEP-C6052P; U4 – National LM311N or Motorola MLM311P1; U5 – National LM380N. All capacitors 50 V mylar except where indicated.

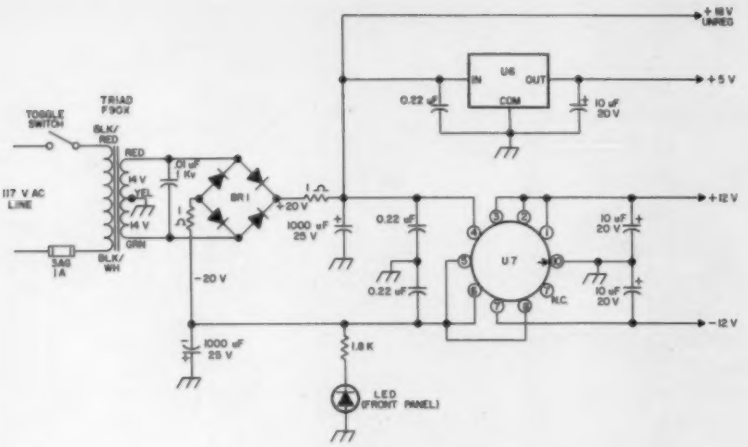


Fig. 2. U6 – National LM341-5 or Motorola MC7805 or HEP-C6110P; U7 – National LM326H (with T05 finned dissipator clip-on); BR1 – Motorola MDA920-3 or HEP-R0802 integrated bridge; LED – HP5082-4882 (Hewlett-Packard) or Motorola HEP-P2000.

driving TTL or DTL logic directly, if a digital system is to follow this unit. In such cases, the 5.1k load resistor may be omitted, since only current *sinking* is required with these logic ICs. If the digitized output is to be used to drive a pen recorder or a logic family like RTL or CMOS, the resistor is required.

U5 is a simple audio amplifier to allow the CW signal to drive a speaker directly. The National LM380N audio amplifier IC used here requires fewer peripheral components than most such ICs, operates on the unregulated + voltage at hand, and will drive an 8Ω speaker. The input to this audio amplifier is selectable from three points in the processor circuitry: following the clipper; following the clipper and bandpass filter; or following the clipper, bandpass filter, and injection locked oscillator. Thus, one may listen to as much or as little of the processing as he desires for each particular signal.

The power supply for the CW processor produces +18 volts unregulated, +12 volts regulated, +5 volts regulated and -12 volts regulated. The ±12 volts is provided by a special dual regulator IC by National: the LM326H. The +5 volt regulated is provided by one of the simple three terminal regulator ICs now widely available from several IC suppliers. The basic bridge rectifier is one of the integrated types from Motorola, for simplicity of construction. The power indicator is an LED type for long life, and operates at 10 mA from the -18 volt unregulated bus.

Since the CW processor has an input impedance of about 1000 Ohms, it can be driven by the output of nearly any receiver. It is a good idea to substitute a resistor of the nominal speaker impedance of the receiver, and then connect the processor across that resistor. For 4, 8, and 16Ω speakers, the additional 1000Ω will cause no appreciable mismatch. For a receiver with a 600Ω output impedance (like the R390A), a resistance of 1,500Ω would be used, so that the parallel combination comes out 600Ω .

In operation, when one is in the "clipped" position, the audio should sound pretty much as it would from the receiver by itself. The only difference should be that large impulsive noises are limited. The roar and grind of received background noise will be just as fatiguing as ever, however. In the "clipped and filtered" position, a CW signal (properly tuned to an 800 Hz beat) will take on a "soft" sound, and the grinding background noise will be considerably decreased. Finally, in the "processed" position, a CW signal (properly tuned to 800 Hz) will appear to "pop in and out" with slightly off-frequency heterodyne signals in the background at a considerably reduced level. If the oscillator gain control is set too close to the verge of self-oscillation, incoming noise will give an oscillator output that sounds much like a narrow crystal filter "ringing" with noise input. Too high an injection level will cause the background off-frequency signals to be objectionably high. The user must make the final compromise in setting these controls on a subjective basis. ■

References

1. Paine, J., "The Paine Killer," *CQ*, May 1964, p. 33.
2. Gonzales, C., "An Automatic Radiotelegraph Translator and Transcriber," *Ham Radio*, Nov. 1971, p. 8-23.
3. Tobey, Graeme, Huelsman, "Operational Amplifiers, Design and Application," 1971, McGraw-Hill, Ch. 8.

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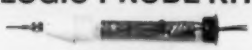
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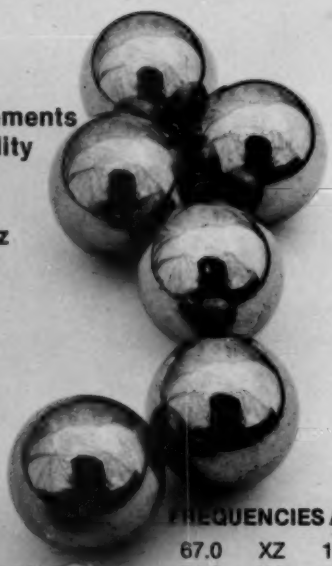

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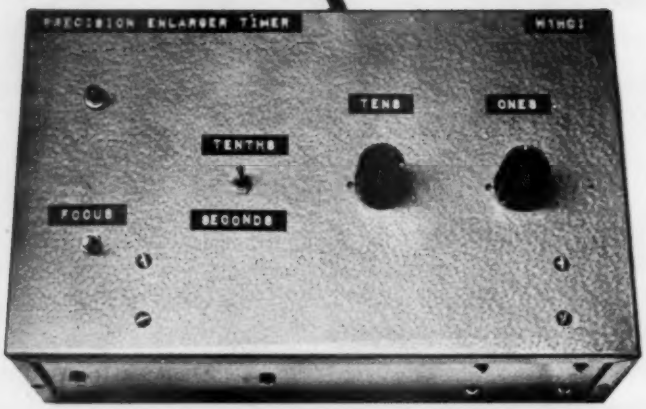


George R. Allen W1HCI
80 Farmstead Lane
Windsor CT 06095

Dependable Timer

-- for darkroom, repeater, etc.

This article describes a 60 Hz, line frequency based precision interval timer designed for use as a repeater timer, a photographic enlarger timer or general purpose timer where accurate, consistent time cycles are required. It is programmable by switches, is reliable, and requires no alignment or adjustment. It is accurate to ± 1/60th of a second.

While numerous articles have been published on simple interval timers, the majority of these timers have major drawbacks of one type or another. Timers using the 555 chip are subject to false triggering in a lot of cases. UJT timers such as those I described in my article "Simple Repeater Control Timers"[1] are temperature sensitive and will suffer a change in time interval as the temperature varies. This is especially annoying for repeater timers where the "three minute time" interval gets shorter and shorter as the temperature gets colder. In addition to these drawbacks, any timer which uses an RC network as the time determining network will suffer from problems when long time intervals are required, since the RC network becomes a high impedance network in this instance. Internal resistance in capacitors and high resistance flux shorts will

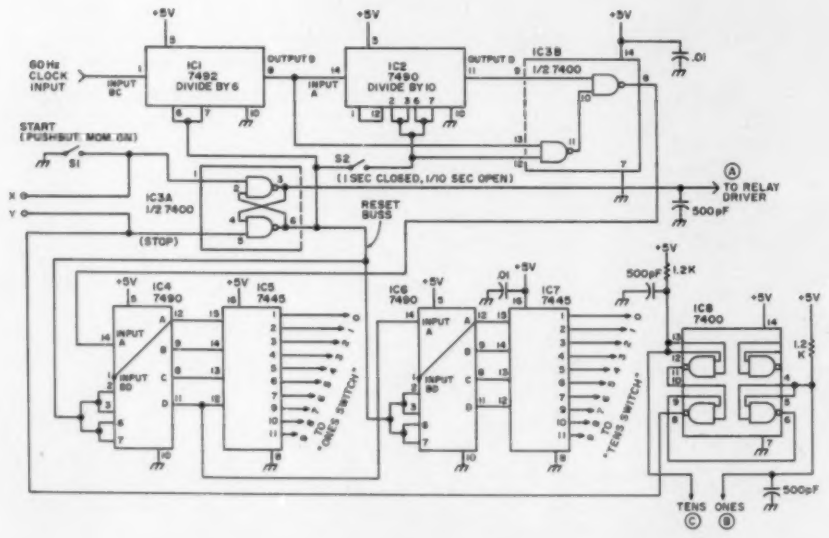


Fig. 1. Basic timer circuit.

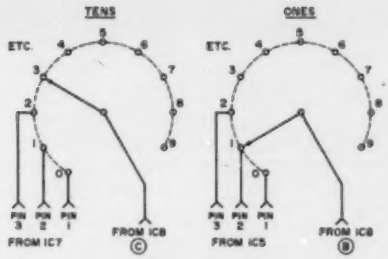


Fig. 2. Switch wiring.

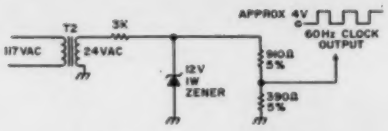


Fig. 3. 60 Hz clock.

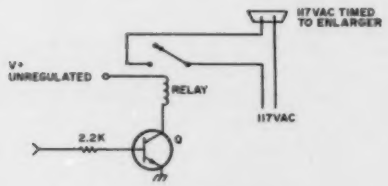


Fig. 4. Relay driver.

create havoc with these high impedance circuits. Furthermore, in cases such as an enlarger timer where it is necessary to select different time intervals, problems arise with selection of precision timing capacitors and resistors, or problems arise in that each timing range must be adjusted.

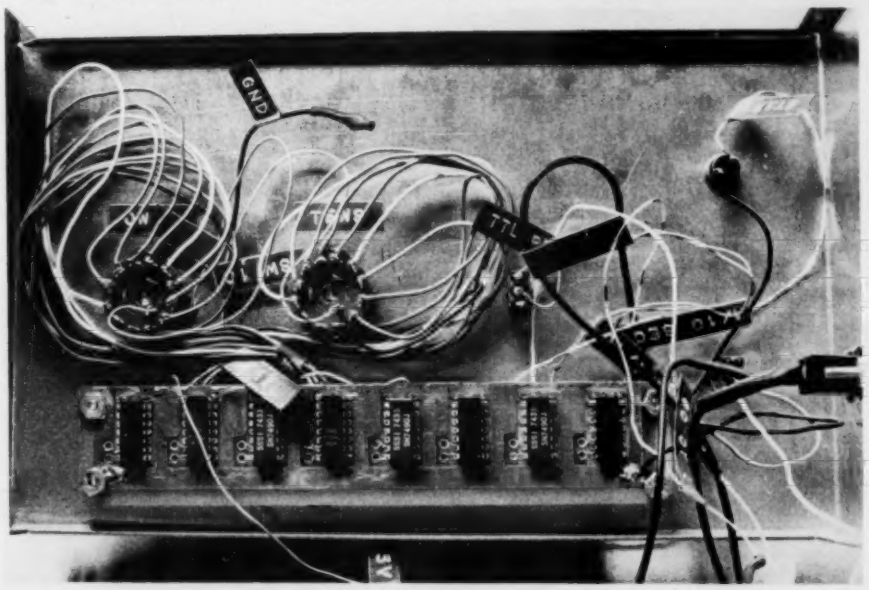
The primary disadvantage of the circuit described in this article is that it is time consuming to wire up 8 integrated circuits. The advantages, however, are numerous. This timer does not suffer from any of the problems previously mentioned. It will maintain its accuracy over a temperature range of 0°C to 70°C and will operate over a range of −55°C to +125°C merely by using the next better grade of IC (military grade). It takes no special skill to build and requires no special equipment to align. In spite of the fact that the basic circuit uses 8 ICs, the timer is not expensive to build. The cost of the 8 ICs is $7.50; the two good quality switches will run about $9.00. If you have a good junque box, there should be little additional expense.

Theory of Operation

This precision interval timer is not a complex device. It is merely a counter that counts pulses in either one second or 1/10 second intervals. A pair of switches is used to set the desired number of pulses to be counted. When the counter has counted the number of pulses set on the switches, the counter stops. The eight integrated circuits perform all functions needed to do the counting and to determine if the desired count is reached. The 60 Hz power line through a 24 V ac transformer and associated circuitry is used as the "clock," a source of pulses occurring at a 60 Hz rate (Fig. 3). The 60 Hz line frequency is accurate when obtained from commercial power lines. You can prove this to yourself by determining the amount of error in an electric synchronous clock over a month's time. The percentage of error is a small fraction of a percent. A dropping resistor, a zener diode and a voltage divider network are used to provide the required 4 volt pulses.

The 60 Hz pulses as they come from the clock are divided by 6 in IC1 (Fig. 1), producing a train of pulses occurring at 1/10 second intervals. For time intervals of short duration, these 1/10 second pulses are counted directly. A 7490 decade counter (IC2) is used to divide by 10 to give a stream of pulses occurring at 1 second intervals. This 7490 is switched in or out of the circuit by a series of gates in IC3, a 7400, depending on the setting of switch S2. If S2 is closed, counting will be by 1 second intervals. If S2 is open, counting will be by 1/10 second intervals.

The count is started by momentarily pressing the start button, S1. This "sets" the set-reset flip flop made from gates of IC3A, a 7400. At this point, all counters are reset and ready to count, and the relay is turned on. IC4, a 7490, is used to count by ones and deliver a BCD output to the 7445 decoder, IC5. The tens output of IC4 goes to the input of IC6, for a count by tens. IC7 decodes the BCD output from IC6. The outputs of the 7445 BCD to decimal decoder will sink current or go low when the proper count is reached. If



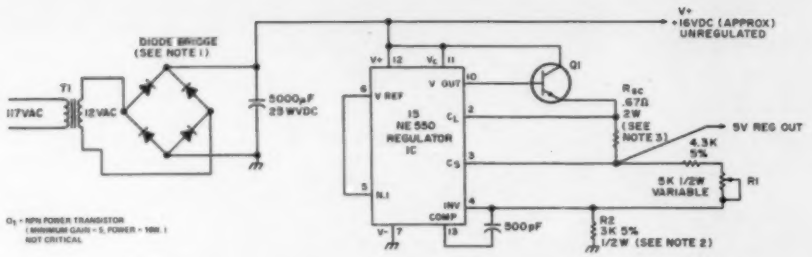


Fig. 5. Power supply. Notes: 1. Use either four 1A 60 piv diodes or an inexpensive diode bridge unit. 2. Using fixed instead of variable resistance, R1 should be 6.15k 1% and R2 should be 2.97k 1%. Using circuit shown, adjust for 5 V dc out. 3. Use four 2.7 Ohm ½ W resistors in parallel.

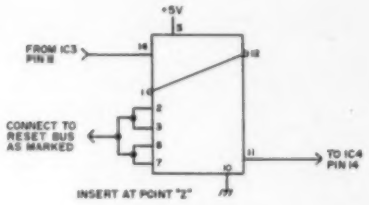


Fig. 6. Increasing time interval by factor of ten.

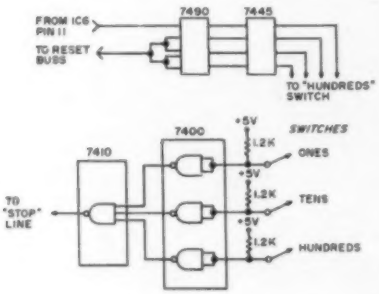


Fig. 7. Adding an extra power of ten with switch.

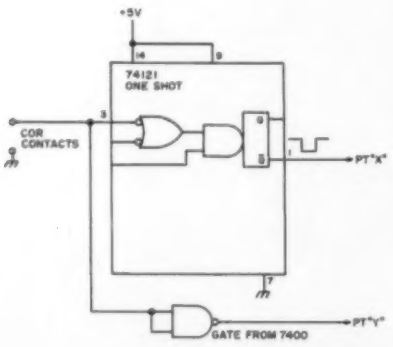


Fig. 8. Repeater timer interface.

you were to connect a low current lamp from +5 V to the "9" output on one of the 7445s, the lamp would light whenever a count of nine were reached. A series of gates is used to logically "AND" the switch selected outputs of the two decoders together to produce a stop pulse. When a stop pulse occurs, the set-reset flip flop in IC3A is reset, turning off the relay and turning off and resetting all counters.

The basic circuit as shown in Fig. 1 can be used in any environment where manual operation may be used. I used my timer as a high quality photographic enlarger timer. I merely plugged the enlarger into the 117 V circuit switched by the relay.

In any case where automatic start or automatic reset is required, the two connections X and Y should be used. Grounding point X will start the circuit and grounding point Y will reset the circuit before the timing interval is complete.

In order to use the circuit as a repeater timer, some minor additional circuitry is required. The circuit in Fig. 8 is connected between the COR and points X and Y. The contacts of the relay are connected to the push to talk circuit. This simple circuit in Fig. 8 delivers a fast pulse to the start circuit when the COR contacts are closed. When the COR contacts are open the stop line is grounded, resetting the timer and turning the relay off. In operation, the switches are set to the "time-out" time desired. If the input signal remains on for too long, the time interval will be passed, a stop pulse will be generated and the relay will open up.

Note that the basic timer will time to 99 seconds, an interval which should be long enough for most applications including a repeater time-out timer. In the event that a longer time interval is required, the time interval may be lengthened by a factor of ten by inserting an additional 7490 integrated circuit into the circuit at point "Z" as shown in Fig. 6. If you wish to program this timer to three significant digits, rather than the two provided, then use the circuit in Fig. 7 instead, to add on one more switch and an additional power of ten. Note that only one additional 7490 may be added into the circuit using Figs. 6 or 7 without increasing the driving capability of the set-reset flip flop in IC3A.

The power supply is not a critical item. Feel free to use other circuits such as circuits using simple three terminal regulators. The eight ICs and the relay draw only 250 to 300 mA, so a fancy supply is not required. The circuit used is the one recommended by Signetics.[2]

Construction

Most builders have a tendency to cram too much into too small a space. For that reason I used a big 16x6x3½ inch minibox. If you use what is available from the junque box, you will probably need all the room available.

In my unit, I mounted the power supply, the relay, the relay driver and the components for the 60 Hz clock on the bottom of the chassis. I then used a piece of IC breadboard to mount the ICs on, and then mounted the PC board and the switches on

the top as shown in the photograph. You may make your own PC board or you may use a breadboard such as Vero #11821, available from Cramer for $7.35. If you wish you may also use Vector board or the equivalent.

When you are wiring the basic timer, you will want to consider the question of whether or not to use IC sockets. In my unit, I wired to the ICs directly with sockets. If you use surplus ICs or have a habit of blowing ICs, then use sockets. Remember that sockets are expensive and decrease the overall reliability of your unit. After completing all solder connections to the basic timer board, clean the board well with a toothbrush dipped in Tri-Clor-Ethylene or similar solvent. Clean the board until all traces of flux are gone. Flux that remains on the board may cause trouble initially. If it doesn't cause a problem right away, it will later on.

The only components which are critical are the switches. In this circuit, the switches handle very little current; thus there is not enough current being switched to keep the contacts clean. Because of this, it is important to use a good enclosed switch, or a switch made for IC work.

Conclusion

The timer described in this article has been used primarily as an enlarger timer in the darkroom. It has been successfully used for quite some time now. I have also tested it as a repeater timer for an experimental repeater which we worked on in the Hartford CT area. If you follow the hints in this article and make no wiring errors, it should work the first time. Good luck. ■

[1] G. Allen, R. Sobus, *Ham Radio*, Sept. 1972, p. 46.

[2] *Integrated Circuits*, Signetics, 1972, p. 6-47.

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What's Up on 156 MHz?

--meet the marine world above 2m

The tide was out and the digital depth sounder buzzed an under-seven-feet warning in the cabin of the sloop *Freelance* as I cranked over and warmed up the diesel. Overhead, beside the companionway from the cockpit, the marine VHF FM rig chattered with Saturday morning pilots looking for signal reports.

I pushed in a button marked WX-2 on the transceiver and a continuous weather broadcast from Washington told me it would be a sunny September day with a peppy 12 nautical-miles-per-hour breeze. Depressing a red priority button on the Hy-Seas 55 marine rig brought its receiver back to channel 16, the emergency and general calling frequency monitored by all boats on the Bay. A quick cracking of the squelch verified the transceiver was receiving.

The depth sounder transponder, mounted in a hole through the hull under the bow of the single-masted sailboat, triggered a buzzer in the cabin as small waves got behind the seawall of the marina and rocked the boat. Whenever the transponder-to-bottom distance was less then seven feet, the in-cabin buzzer sounded.

Climbing the companionway stairs out of the cabin into the cockpit, I stationed myself behind the pilot wheel and slipped the diesel into reverse. The 31-foot fiberglass sloop chugged backwards out of slip 91. Clear of the moorings, I put the helm hard over and powered forward into open water of Annapolis harbor.

I glanced at my chart of the harbor waters and compared depths marked on that map with sounding depths being read out on a digital display in the cockpit. Motoring ahead to a point off the Severn River, I turned to starboard, facing the giant naval radio towers on Greenbury Point and the wide harbor mouth opening into Chesapeake Bay.

I leaned back down the companionway into the cabin and killed the diesel. Reaching up, I listened again to WX-2 on the marine radio for a prediction of wind speed and direction. The broadcast outlook appeared to compare correctly with indications of my red yarn wind telltales tied halfway up the mainmast shrouds. I punched the radio back to channel 16. The Yaesu FT-101-B HF transceiver was lashed to the navigating table in the cabin and my Wilson two meter handheld was strapped to the cabin bulkhead in arm's reach of the cockpit hatch.

With WN3AIQ maintaining the helm in the direction of the Bay, I went on deck to free the mainsail and run it up smartly. I winched the jib sheet to a moderate tension on the sail as we moved on the wind. The 5/8 wavelength VHF gain antenna 40 feet above on the masthead bent slightly toward the stern in the wind.

Parked in the Bay ahead were three huge freighters and a tanker, bound for Baltimore harbor. WN3AIQ turned up the volume on the marine rig and switched to commercial channels to see what the sailors from foreign lands were talking about (see Table 1 for uses made of different VHF FM marine radio channels).

A Greek freighter had sent a dozen crew members into Annapolis on shore leave. They were returning in a large orange dinghy. One was talking with the bridge of his ship, using a handie-talkie like the two meter HTs. We sailed straight out into the Bay toward Kent Island to inspect the Greek reboarding operation.

Circling the freighter, not an easy task under full sail, we headed south toward the Thomas Point Lighthouse. The tide was still going out so we moved down the Bay at what we calculated was a rapid seven knots. That's when eavesdropping on the marine channels got exciting.

The freighters were behind us, and we felt guilty about not monitoring channel 16 so we switched back to that frequency (see Table 2 for VHF FM marine radio channel numbers and their corresponding frequencies).

Almost immediately we heard, "Coast Guard Annapolis. Coast Guard Annapolis. This is *Sea Scraper*. The yacht *Sea Scraper*. Whiskey Zulu Yankee Four Nine Six Seven."

The quick response was, "The yacht calling. This is Annapolis Coast Guard."

"Coast Guard. We're aground on shoal near Thomas Point Light," *Sea Scraper* came back. WZY-4967 was his FCC-assigned VHF FM marine radio call letters.

"Can you go to channel 22?" the Coast Guard radio officer asked.

"Yes, we can. This is *Sea Scraper* going to channel 22," the yacht skipper replied before QSYing to the Coast Guard channel.

The Coast Guard radioman said on channel 16, "*Bay Chaser*. Coast Guard Auxiliary Vessel, *Bay Chaser*. This is Coast Guard Annapolis. Come in."

Three long-time Bay sailors, volunteers in the Auxiliary, had been cruising in their power boat in the Bay off South River. "Go ahead Annapolis. This is *Bay Chaser*."

The Coast Guard asked if *Bay Chaser* would QSY to channel 22 to establish communications and help out in the *Sea Scraper* emergency. *Bay Chaser* left channel 16. WN3AIQ switched our 55-channel marine rig to channel 22 to listen in.

Rendezvousing on channel 22, the Coast Guard explained the problem to *Bay Chaser*. *Sea Scraper* had ven-

Function	Channel Number	Frequency MHz Ship Transmit	Shore Transmit	Point-to-point	Kind of Traffic
distress, safety and calling	16	156.8	156.8	ship to ship ship to shore	distress and calling
intership safety	6	156.3	156.3	ship to ship	safety
navigation	13	156.65	156.65	ship to ship ship to shore	locks, canals, pilots, bridges
environment	15	-------	156.75	shore to ship receive only	environmental, hydrographic
state control	17	156.85	156.85	ship to shore	governmental secret
port operations	12	156.6	156.6	ship to ship ship to shore	US Coast Guard
	14	156.7	156.7	same as 12	USCG and port authorities
	20	157.0	161.6	same as 12	port operations
	65A	156.275	156.275	same as 12	same as 20
	66A	156.325	156.325	same as 12	same as 20
	73	156.675	156.675	same as 12	same as 20
	74	156.725	156.725	same as 12	same as 20
commercial	7A	156.35	156.35	ship to ship ship to shore	commercial business
	8	156.4		ship to ship only	same as 7A
	9	156.45	156.45	ship to ship ship to shore	same as 7A
	10	156.5	156.5	same as 9	same as 7A
	11	156.55	156.55	same as 9	same as 7A
	18A	156.9	156.9	same as 9	same as 7A
	19A	156.95	156.95	same as 9	same as 7A
	67	156.375		ship to ship only	workboats
	77	156.875		ship to ship only	commercial, business
	79A	156.975	156.975	same as 9	same as 7A
	80A	157.025	157.025	same as 9	same as 7A
	88A	157.425		ship to ship only	fishing vessels
non-commercial	9	156.45	156.45	ship to ship ship to shore	clubs, marinas, yards, etc.
	68	156.425	156.425	same as 9	yachts
	69	156.475	156.475	ship to shore only	clubs, marinas, yards, etc.
	70	156.525		ship to ship only	yachts
	71	156.575	156.575	ship to shore only	same as 69
	72	156.625		ship to ship only	yachts
	78A	156.925	156.925	ship to shore only	same as 69
	83CG	157.175	157.175	ship to ship ship to shore	US Coast Guard's Auxiliary only
public correspondence (telephone calls)	24	157.2	161.8	ship to coast	telephone calls
	25	157.25	161.85	ship to coast	telephone calls
	26	157.3	161.9	ship to coast	telephone calls
	27	157.35	161.95	ship to coast	telephone calls
	28	157.4	162.0	ship to coast	telephone calls
	84	157.225	161.825	ship to coast	telephone calls
	85	157.275	161.875	ship to coast	telephone calls
	86	157.325	161.925	ship to coast	telephone calls
	87	157.375	161.975	ship to coast	telephone calls
NOAA weather service	WX 1		162.55	receive only	weather broadcasts
	WX 2		162.4	receive only	weather broadcasts

Table 1. How VHF FM Marine Radio Channels Are Used in the USA.

tured into shoal waters of about three-foot depth while attempting to get up close to photograph the picturesque old Thomas Point Lighthouse. *Sea Scraper* had plowed so far into soft mud on the bottom of the Bay she was stuck. The captain had tried to power backwards out of the hangup but couldn't budge the craft.

Bay Chaser established direct communications with *Sea Scraper* on channel 22 while the Coast Guard stood by. Coast Guard also kept one ear cocked toward channel 16 in case other emergencies came along.

"*Bay Chaser*. This is *Sea Scraper*. We may have damaged our hull. We're taking on some water in the engine room." The Auxiliary tried to speak soothingly to those listening aboard *Sea Scraper* while maneuvering in close enough to toss over a line.

WN3AIQ went forward, leaning out into the pulpit for a better view. We sailed silently nearer the action scene, without coming close enough to interfere. Mean-

Channel Number	Frequency MHz		Kind of Traffic	Function	
	Ship Transmit	Shore Transmit		Ship to Ship	Ship to Shore
1	156.05	160.65	international only		x
2	156.1	160.7	international only		x
3	156.15	160.75	international only		x
4	156.2	160.8	international only		x
5	156.25	160.85	international only		x
6	156.3		safety	x	
7	156.35	160.95	international only		x
7A	156.35	156.35	commercial	x	x
8	156.4		commercial	x	
9	156.45	156.45	commercial	x	x
10	156.5	156.5	commercial	x	x
11	156.55	156.55	commercial	x	x
12	156.6	156.6	port operations and US Coast Guard	x	x
13	156.65	156.65	locks, canals, pilots	x	x
14	156.7	156.7	ports, US Coast Guard	x	x
15	156.75	156.75	environmental	ship receive only	
16	156.8	156.8	distress and calling	x	distress call
17	156.85	156.85	state control		x
18	156.9	161.5	international only	x	x
18A	156.9	156.9	commercial	x	x
19	156.95	161.55	international only	x	x
19A	156.95	156.95	commercial	x	x
20	157.0	161.6	port operations	x	x
21	157.05	161.65	international only		x
21CG	157.05	157.05	US Coast Guard only	x	x
22	157.1	161.7	international only		x
22CG	157.1	157.1	US Coast Guard	x	x
23	157.15	161.75	international only		x
23CG	157.15	157.15	US Coast Guard	x	x
24	157.2	161.8	telephone calls		x
25	157.25	161.85	telephone calls		x
26	157.3	161.9	telephone calls		x
27	157.35	161.95	telephone calls		x
28	157.4	162.0	telephone calls		x
60	156.025	160.625	international only	x	x
61	156.075	160.675	international only	x	x
62	156.125	160.725	international only	x	x
63	156.175	160.775	international only	x	x
64	156.225	160.825	international only	x	x
65	156.275	160.875	international only	x	x
65A	156.275	156.275	port operations	x	x
66	156.325	160.925	international only	x	x
66A	156.325	156.325	port operations	x	x
67	156.375		commercial	x	
68	156.425	156.425	non-commercial	x	x
69	156.475	156.475	non-commercial		x
70	156.525		non-commercial	x	
71	156.575	156.575	non-commercial		x
72	156.625		non-commercial	x	
73	156.675	156.675	port operations	x	x
74	156.725	156.725	port operations	x	x
77	156.875		commercial	x	
78	156.925	161.525	international only	x	x
78A	156.925	156.925	non-commercial		x
79	156.975	161.575	international only	x	x
79A	156.975	156.975	commercial	x	x
80	157.025	161.625	international only	x	x
80A	157.025	157.025	commercial	x	x
81	157.075	161.675	international only		x
82	157.125	161.725	international only		x
83	157.175	161.775	international only		x
83CG	151.175	151.175	USCG Auxiliary only	x	x
84	157.225	161.825	telephone calls		x
85	157.275	161.875	telephone calls		x
86	157.325	161.925	telephone calls		x
87	157.375	161.975	telephone calls		x
88	157.425	162.025	international only	x	x
88A	157.425		commercial	x	
WX 1		162.55	NOAA weather broadcasts	ship receive only	
WX 2		162.4	NOAA weather broadcasts	ship receive only	

Table 2. Channel Numbers and Frequencies in Use in the VHF FM Marine Radio Service.

while, we heard all that was going on via radio.

The Auxiliary, with a shallower draft, motored close enough to *Sea Scraper* to throw a line. We could see a woman and two children on the *Scraper*. The skipper grabbed the three-quarter-inch rope as it slapped his deck. He quickly tied off the line to a stern mooring cleat. The Auxiliary turned stern toward the *Scraper* and very slowly drew the line taut. Forward power in the *Bay Chaser* brought the *Scraper* out of the mud and back into six feet of water where she floated free.

"Stand by. We'll come aboard to check that water in your engine compartment," *Bay Chaser* radioed to *Scraper*. The Auxiliary pulled alongside *Scraper* and they rafted together with lines cleated fore and aft on each boat. One of the men on the Coast Guard Auxiliary went over the lifelines onto *Scraper's* deck, and then below to look at the possible leak. Pretty soon we heard this on channel 22:

"*Bay Chaser*. This is *Sea Scraper*. Joe, this is Fred. There must have been a rock outcropping in that bottom mud. He has a very small dent where the hull seems to have been crunched in by passing over something hard. There's a tiny crack letting water seep in."

The reply was, "OK, Fred. You stay on board. We'll take them in tow to South River Marina. They can get things checked out there."

With that, things got routine even though the channel 22 communications continued for some time. The Auxiliary untied from the *Scraper* and hooked a line from its stern to the bow of *Scraper*. *Bay Chaser* began pulling *Sea Scraper* toward the nearest boatyard where damage could be surveyed and repairs made. Radio contact was maintained with an

occasional transmission from Joe to Fred.

With WN3AIQ at the helm, I reached into the cabin and changed the radio back to WX-2. The special forecast for Chesapeake Bay was on. The day would continue to be pleasant; the evening would be fine. I checked WX-1 and found a different government station transmitting. It also was full quieting in the receiver. When sailing in the Annapolis area, I usually pay attention to WX-2, but WX-1 could be used. Their forecasts overlap. One or the other of the two weather frequencies hold loud and clear signals wherever you are on the Bay.

Back on channel 16, the communications were only those which could be justified as necessary. Occasionally, a skipper would pop up on frequency asking for a "radio check." Somebody would come back, "You're loud and clear." Both boats would identify by boat name and FCC call letters. Radio checks are in the gray area of legality and are not encouraged by the Coast Guard. But, sometimes a skipper gets edgy about who would be able to hear him in an emergency. He asks for a fast radio check and usually gets it.

Communications heard regularly on channel 16 might include pleasure boats hailing each other by boat name and radio call letters; pleasure boats calling the Coast Guard or being called by the Coast Guard; Coast Guard and marine police calling each other and their auxiliaries; freighters, tankers, fishing boats and other commercials hailing other ships, ports, marine police or the Coast Guard; or telephone operators paging both pleasure boats and commercial ships for which telephone calls are waiting.

All of this calling is done with radio operators careful to identify fully by boat name and call. As soon as communications are established, both parties leave channel 16 for a channel specifically authorized for their QSO. For instance, work boats might go off onto channel 67. Fishing vessels might QSY to channel 88A. A pleasure boater might leave channel 16 for channel 9 after getting in contact with his marina or yacht club. The telephone operators ask you to call them back on specific channels between 24-28 and 84-87.

By the way, as with all radio communications except broadcasting and ham transmissions, you can listen all you want but you cannot repeat legally what you heard. And you can not use information heard on the air for your own personal gain. If you hear a boat being paged on channel 16 by your local marine telephone operator and you QSY to a channel to hear the conversation between boat and shore, don't tell anybody what you heard. And don't make any use of the information contained in the telephone call. The *Sea Scraper* emergency reported here is composed of parts of many I have heard on the Bay.

With the excitement over for the moment after the rescue of *Sea Scraper*, we left the marine rig monitoring 16. Unstrapping the Wilson, we keyed up the Jessup MD .16/.76 repeater from atop 100 feet of water in the middle of the Bay. A quick QRZed on .52/.52 raised Charlie WA3RPU, piloting his giant motor-freighter near the Sandy Point Light en route to Norfolk. But using HF and VHF ham gear maritime mobile is a story for another time. Next time you're boating on the Chesapeake, call *Freelance* WYN-2260 on channel 16. We could QSY to .52/.52 for a quick QSO. ■

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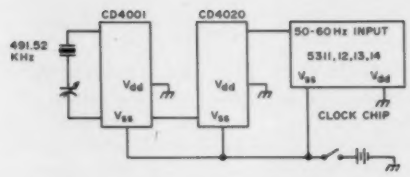

Fig. 1. Crystal oscillator, 13 stage binary divider.

Oops! There Goes the Power

-- keeping digital clocks going anyway

Digital clocks have long held a fascination for me, and judging from the number of articles in electronics publications, they also hold a high attraction for many other people. I've gone through all the stages from a complete discrete (?) integrated circuit clock with minitron readouts to the latest MOS clock chips with LED readouts. As a result, I have learned a few lessons which should be of interest to other "clock fanatics."

One of the most frustrating problems with any ac powered digital clock is its volatile memory – that is, when the power fails for even an instant, the memory of the displayed time is destroyed, and when power is restored, the clock will not display the correct time. With some MOS chips, the clock will reset to 12:00:00 or 00:00:00, while with others any time may be displayed, even impossible times such as 28:42:00. Several methods of preventing this situation are available: (1) Use a crystal oscillator timebase and battery power; (2) Use the ac line for timebase and primary power with battery power to prevent memory dump when the ac power fails; and (3) Use the ac line with capacitor backup as a power source when the ac power fails for momentary retention of clock memory. Obviously, (1) is the most desirable setup since the clock can then be used in a car, boat or any portable requirement. It is the least desirable from the standpoint of cost and complexity. A partial diagram of such an arrangement using the 53XX series of clock chips is shown in Fig. 1. (2) is a relatively uncomplicated arrangement which prevents loss of memory and, depending upon the length of time that the ac power is off, will provide good service. The clock is not triggered during the time the power is off and will show a loss of time when the power returns. Also, during the power off time, the display will not be illuminated. Since the displays draw the majority of power, only the clock chip is battery powered during the ac power failure. Fig. 2 shows a partial diagram of the battery powered arrangement. Either dry batteries or rechargeable batteries can be used and are depicted in Figs. 2(a) and 2(b) respectively. In effect, the battery "floats" across the rectified ac power source and is switched on by diode D1 upon failure of the ac power. Note also the use of diode D2 which isolates the display power from the battery. If this diode is not installed, the battery will be quickly discharged by the display current drain. In Fig. 2(b), a method is shown which will keep the rechargeable nicad battery on trickle-charge from the ac power source. Solution (3) is one of the best solutions to the problem that I've found. Most power failures are of a momentary nature (less than 2 – 3 seconds) in areas where I've lived, and these are the most frustrating for clock owners. In some cases, the failure is not even noticed, yet the clock's memory is destroyed and the clock must be reset. To overcome this problem, I now use the circuit in Fig. 3. Notice that the only addition to the standard clock circuit is one diode. This diode acts as a switch. During normal ac operation, the switch is

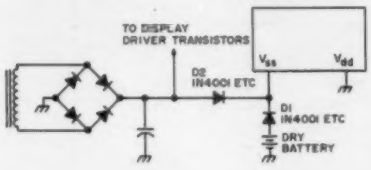

Fig. 2(a). Dry battery memory backup.

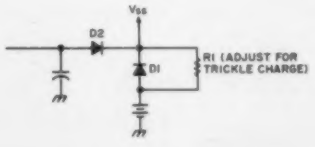

Fig. 2(b). Trickle charger battery backup.

closed and power flows from the bridge rectifier to the display directly, and through the diode to the filter capacitor and the clock chip. Upon power failure, the diode switch is reverse biased by voltage stored in the filter capacitor and the display is not illuminated. However, power from the capacitor flows continuously into the clock chip for several seconds and the memory is retained. Since the MOS chips draw only about 8 mA and will operate down to about 7 to 8 volts, the capacitor can supply power for several seconds. By using a 14 volt supply and a 3,000 uF capacitor, approximately 5 seconds will pass before memory destruction occurs. This is by far the least complex and least expensive method of improving the reliability of digital clocks.

One other tidbit of information concerns the 50252 clock chip sold by Radio Shack and other dealers. This chip requires that you depress both the tens-of-minutes and hours time set switches to advance the minutes display. This is somewhat cumbersome and more times than not I advanced the tens-of-minutes digit or the hours digit because the switches were not depressed simultaneously. The solution involves a third switch and two diodes (1N4148s or similar) and is shown in Fig. 4. The added switch now advances only the minutes display with no worry of accidentally advancing any of the other displays. This particular clock chip has several desirable features such as 24 hour alarm, 10 minute snooze alarm and a built-in tone generator for the alarm. However, it does have one disadvantage which is not immediately obvious — it cannot be operated in the 24 hour mode on 60 Hz power. This feature is a matter of individual preference and was somewhat of a disappointment, to me. I'm unable to figure out why the chip functions like this since the alarm feature always operates in the 24 hour mode regardless of the input power line frequency (50 or 60 Hz); however, the display will only operate in the 24 hour mode when the input is 50 Hz.

Since many of the MOS clock chips are now in the $5 range, uses other than just a timekeeper should be explored: frequency division for counters or synthesizers, portable timers for sporting events, etc. It appears there are many possibilities and if you have some ideas, I'd like to hear from you. ■

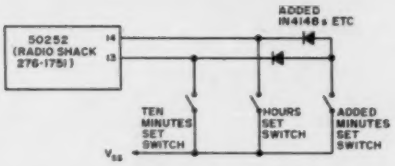

Fig. 4. Setting circuit for 50252 chips.

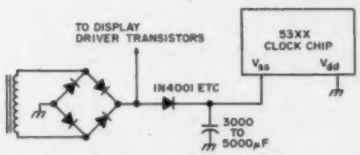

Fig. 3. Capacitor backup for short-term memory protection.

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TT Pad for the Wilson HT

-- and a belt clip mod, too

In November, I attended the ARRL New England Division Convention in Hartford and took along my Wilson 1402SM two meter FM hand-held transceiver. I wore it on my belt and with its miniature touchtone pad, it attracted the attention of many hams.

A number of hams even stopped and asked questions about the rig and some wanted to have a closer look. When I gave them a closer look, they were further impressed by the addition of a belt clip on the back of the transceiver.

There was a lot of interest in my modified Wilson; at one point, there were a half dozen hams surrounding me on the convention floor asking questions (I felt I was conducting an unscheduled technical forum!). And, there are a lot of Wilson owners, so I thought I'd write a how-to article for these hams and all hand-held transceiver owners, since the modifications I made on my transceiver are applicable to most of the other hand-held rigs available today.

After I purchased my Wilson, there were two things I wanted to add – a touchtone encoder and some kind of clip that would permit me to attach and detach the Wilson from my belt or pocket quickly. The Wilson does have an accessory leather case with a belt notch permitting it to be attached to your belt; the problem with this is you must unbuckle and remove your belt each time you wish to use the transceiver and this does not promote swift communications. Also, I like to throw my Wilson in its nicad charger whenever I'm not using it . . . but this isn't easy to do because you must remove the leather case before the rig will fit in the charger. For these reasons, I filed my leather case in the bottom of a desk drawer and looked for a better way.

I noticed that many Motorola HTs have just the kind of clip that I was looking for, and after doing a little inquiring, I found that the clips were available separately from Motorola.[1] I purchased one to try out on my Wilson. To attach the clip to the rig, you have to take the transceiver's plastic case apart. First, slide out the battery pack and remove the four screws on the back and bottom of the unit. The front of the case will then snap off, hanging by a couple of wires. Now, remove the five screws holding the PC board to the back of the case; these screws are located at the corners and center of the board and when they are removed, the back of the case snaps off completely from the rest of the unit.

The belt clip has two holes in it for mounting and two 2-56 x ¼" round head machine screws will do the job. Using the clip, you can make a template and be able to mark the spots on the case where you will have to drill. Be sure these spots are centered on the upper quarter of the case.

Use a hand drill and not too much pressure or you might crack the plastic case. After the holes have been

made, take a small screwdriver and jam it into the belt clip's spring in order to keep the spring open. This permits the clip to be mounted parallel to the back of the case. Now, mount the clip with the two screws; nuts and lockwashers are unnecessary as the clip itself will lock the screws in place. If the mounting is done properly, the heads of the screws won't be in contact with the PC board; however, if it makes you feel more secure, cover the screws with a piece of electrical tape.

Now you can reassemble the case and the job is complete. If you wish, you can spray a couple of coats of paint on the clip to match the color of your rig ... "wrought iron black" did the trick with the Wilson.

When I was looking for a touchtone encoder for my Wilson, I heard about the new Motorola MC14410 IC for touchtone application, and at the same time, Data Signal, Inc.[2] began advertising their touchtone encoder kits which implemented the Motorola chip. For only $24.50 you get the chip, PC board, 1 MHz crystal, the keyboard of your choice and all of the other necessary components. I ordered the small 12-digit keyboard because the larger board mounted on the Wilson would not fit in the nicad charger.

After receiving the "kit," a few wires remained to be soldered and the keyboard had to be mounted on the front of the Wilson. I made a template by tracing the keyboard's mounting posts and pins on paper. After removing the battery pack and front of the case, using the template, I marked the spots to be drilled. The template should be positioned as close as possible to the speaker, so that when the keyboard is mounted, it will be clear of the nicad charger.

After drilling and filing the necessary holes – four for the corner mounting posts and two for the two rows of pins – bring the wires from the PC board through the holes making sure that the wires to be soldered to the right row of pins are brought through the right hole and the wires to be soldered to the left row are brought through the left hole. Solder the wires close to the plastic base of the proper pins and clip off the excess pins; this will provide sufficient clearance for the nicad battery pack.

Carefully mount the keyboard onto the front of the case and use a soldering iron to melt the mounting posts to the inside of the case. The keyboard will be stably mounted.

Now solder the ground wire to the negative battery terminal and the plus 12 volt wire to the VR3 volume/on-off control. If you are using a 12-digit keyboard, there will be one wire left that is used for the 16-digit board; this wire can simply be cut off.

After the wiring is completed, wrap the PC board and crystal with electrical tape and fit it snugly between the crystal switch and front of the case. The board will remain in this position; however, you may want to secure it with additional tape.

Any excess wire should be pulled up and taped near the speaker so that the wires running parallel to the battery pack will lie flat on the case. In addition, this parallel-running wire should be taped down onto the case. Now, reassemble the case, slide in the battery pack and you'll be on the air with your belt-clipped TT'd HT. ■

[1] Part Number 42-82839 JO1 available from Motorola, 85 Harristown Rd., Glen Rock NJ 07452, (201) 447-4000 ... $4.50 will cover the cost of the clip and shipping.

[2] 2212 Palmyra Rd., Albany GA 31701, (912) 435-1764.

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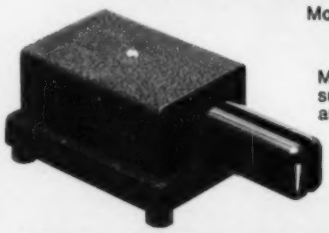

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1200 Exhibits
1300 Bus Tour to Bureau of Standards
1400 Microprocessors for Beginners
1400 Microprocessors for Advanced
1800 General Hospitality Rooms with Entertainment
1900 Microprocessor Sharing Session

Saturday

0700 QCWA Open Breakfast
0800 Exhibits
0900 10X Forum
0900 Powerline Noise Forum
0900 Introduction to Amateur Radio ARRL Staff
1000 DX Forum
Jack Reed, VE3GMT (Member, 1975 Sable Island DXpedition)
1000 Ionosphere Modification Project
1100 Search & Rescue Emergency Communications in N. New Mexico
1100 Optical Communications in the Atmosphere
Dr. Jack Baird (University of Colorado)
1100 Contesters Forum
1200 Lunch
1230 Antenna Forum/Basics
1230 Antenna Forum/Advanced
1230 Advances in Antenna Matching
Jerry Sevick, W2NMI (Bell Labs)
1300 Amateur Radio for the Handicapped
1300 MARS/Combined Seminar
1400 Fiber Optics Communications
Joe Mullins (Bell Labs, New Jersey)
1500 FM Forum
1600 Amateur Radio Talks to the Media
1600 Printed Circuit Board Construction & Demonstration
1700 Free Time
1800 Banquet with Two Featured Speakers
*Father David L. Reddy, CEØAE, of Easter Island fame
*Geoffrey Bryson (Director of Documentary Programming for BBC, London, England)
2100 ARRL Forum
2100 Ladies Variety Show
2400 Wouff Hong Ceremony

Sunday

0530 Sunrise Service at Civic Center (Multi-Denominational)
0700 Open Buffet Breakfast
0800 Registration
0900 Exhibits
0830 MARS/Army, Navy, Air Force
0930 National Bureau of Standards Time & Frequency Service (Time by Satellite)
0930 YLRL Forum
1030 FCC Forum
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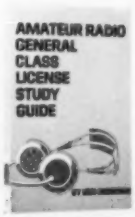

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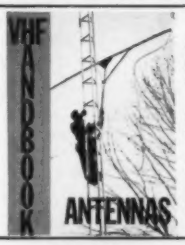

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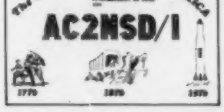

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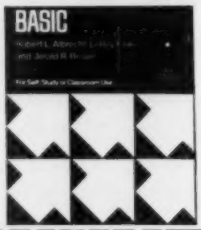

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Bob Lengyel, WB6KDS, worked stations all over the world with an Atlas 210x transceiver installed in his sailboat while crossing the Atlantic single-handed. Bob's faith in the Atlas transceiver to maintain vital communications with the rest of the world is a real compliment to the dependability of Atlas equipment. During this month of June, Bob will be sailing from Portsmith, England, to Newport, RI, in the single-handed Transatlantic race, again depending on his Atlas transceiver for communications.

Dan Lepinski, WA7JUX, from Phoenix has just put 40,000 miles on his motorcycle, making hundreds of QSO's during his travels.

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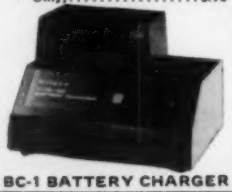

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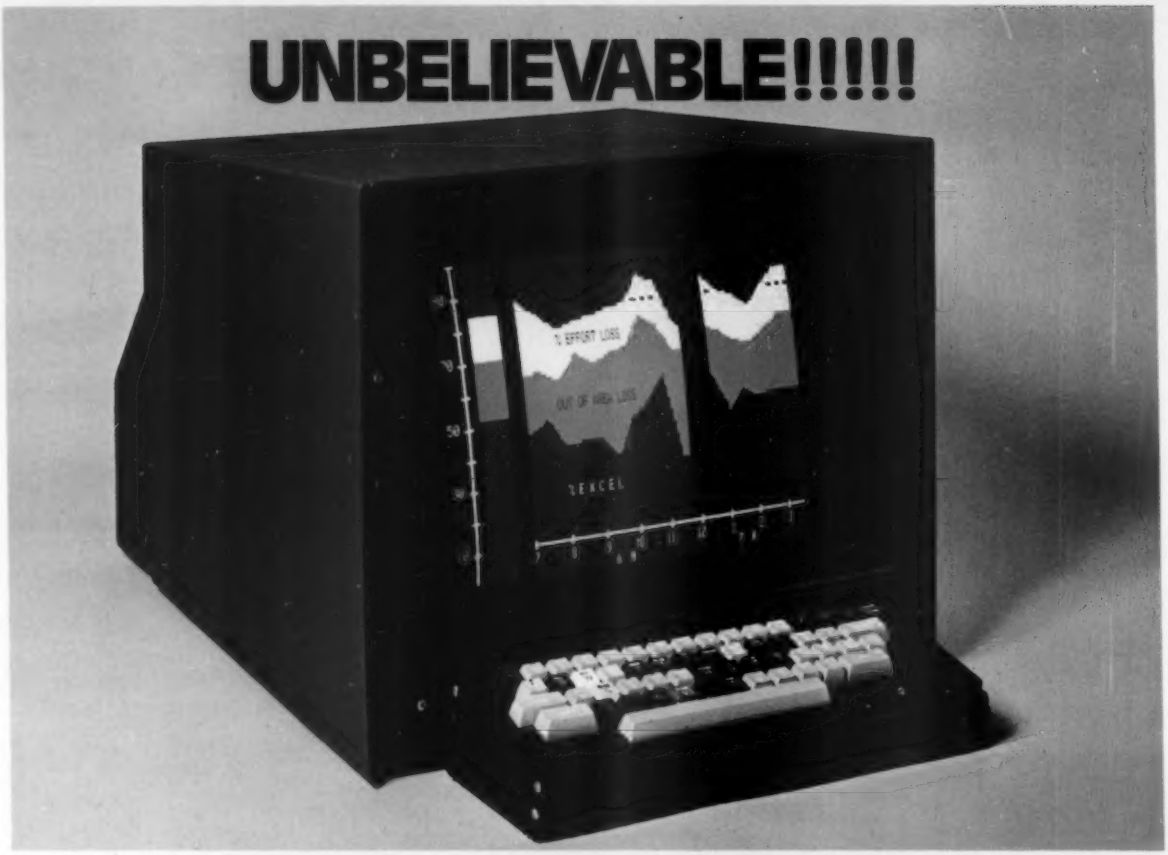

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I/O EDITORIAL

COMPUTER CONVENTION

The MITS World Altair Computer Convention in Albuquerque came off very well with some 500 plus computer hobbyists attending. The convention was run in the Airport Marina hotel, just around the corner from the new MITS plant.

Since only Altair computers were being shown, there were not a lot of exhibits ... but those which were there were of interest. Probably the most exciting was a ham station (WA8VNP) set up and operating in the RTTY contest (which was coincidentally on that weekend). The whole works was being displayed on a CRT with one area for the received copy, one for the copy being typed to be sent, another for checking for duplicates, and a fourth for logging. A built-in clock added the time to each exchange.

All the operator had to do was type in the call of the station to be worked and the report ... the computer then checked to see if that station had yet been worked on this band ... if so, it typed out "Dup." If not, it would go ahead with the contact when given the word to start.

Another system was showing a biorhythm display. It would ask your birthday, how many days you would like shown, and starting with what date ... from there on it would plot your emotional, intellectual and physical curves, showing you why things went so wrong or perhaps what you might expect next week.

Cromemco's TV dazzler was one of those gee-I've-gotta-have things. I'm not sure what it can do, but it was impressive in its ability to show colors on a big color TV set. I suspect that someone into art could work up programs which would be real knockouts.

In view of some past hostility to firms making Altair-compatible boards, it was surprising and comforting to see one competitor there with a display of their boards.

The day and a half of the convention was all too little for all the talking and seeing to be done.

And hams? A substantial number of those who came had HTs sticking out of a pocket!

I finally found out what MITS stands for ... seems they got started in 1969 making telemetry kits ... it is Micro Instrument and Telemetry Systems. In 1970 they got into calculators and by 1974 had taken a terrible beating as calculator prices plummeted. They were just about to give up when they came up with the Altair 8800 computer – and the rest is history.

MY BIG SPEECH

Since the other editors in the field had been asked to give a talk, I came prepared, too ... hoping that perhaps I had just been overlooked. It turned out that I apparently was not in the same league as the others, so I still have my notes.

The basic thrust of my proposed talk had to do with the almost unlimited opportunity that microcomputers afford. I doubt that there has ever been a time in the past when it was possible to see so clearly the opening of a whole new field ... a multi-billion dollar field. Flying pioneers knew they had something, but they had no hint of the magnitude. You have to be fairly old now to remember the almost universal reservations which greeted television in its early years. My folks were really upset when I went out in 1948 and spent $250 for a ten inch black and white set ... a waste of money ... we'll never watch it ... etc. We watched it ... including wrestling, westerns, everything.

The hobby computing field is fantastic. It isn't very big as yet ... in fact, it may never be very large ... but it is going to have a profound effect on the history of the world. The computer hobbyist is going to pay for the technical development needed to build small computer systems which are needed by small businesses, schools and homes.

You can today buy a computer system for about $5000 that would only a couple years ago (or less) cost you around $50,000 ... and this is only the very beginning. Let's look ahead a little ... how long will it be before we have the $299 smart terminal? It will have a black and white TV monitor (they run about $75 new these days) ... a 16K RAM memory for programs and storage ($20?) ... a ROM with text editing and word processing programs ... a printed circuit board keyboard like the ones now used for tone pads on HTs ($5?) ... a video display chip ($5) ... keyboard/ASCII chip ($3) ... etc.

What office desk will be able to be without a desktop terminal? It will be used to type all letters, will work fine for form letters, will act as a file cabinet or card file, calculator, Teletype via phone lines, handle all the bookkeeping and accounting, send invoices, print out labels, inventory, etc. Each office will probably need some hard copy device ... either a line printer or a photo copier to read from the tube. They will need some data bank ... tape, disk ... or something not yet invented ... perhaps like a video disk system.

Every worker in an office will need a terminal ... every retail store will need one to keep track of sales, inventory, costs, etc. Will the computer terminal be as common on school desks of the future as the inkwell was when I went to school?

And how about the home? The terminal here could be used for an almost infinite number of applications ... security ... heating ... grass watering ... message center ... letters ... banking ... ordering from local super market for delivery by electric cart ... ordering from Sears, etc. ... any school course of instruction ... games ... and etc.

I see these markets as inevitable, and I believe that they will evolve from the present computer hobby systems ... with hobbyists both paying the freight for this development and participating in it. I also see this as a very good way for things to go.

Let's suppose that IBM or DEC had the vision to come out with a $299 computer, complete with CRT, keyboard, some ROM programs, RAM memory and the ability to interface with larger memory, other terminals, line printers, etc. It just might happen that their present system of selling would stick ... factory to customer via local factory reps and service centers. That would deal us out of the big ball of wax.

But the present system, which is developing with small manufacturers, local computer stores for sales, programming and service, affords a much more widely based market ... one that can accommodate many manufacturers and still keep prices down. The pricing schedule of the big computer firms is a tough bone, with many items being marked up 100% when sold by other than the manufacturer. A $1500 printer then sells for $3000!

Computer stores will be much like hi-fi stores, carrying equipment of many manufacturers and mating compatible gear. The old OEM price schedule will hold for dealers and the markups will be more like 35% than 100%. Maybe even less.

Continued

One of the tech sessions at the MITS computer convention. Over 500 computer hobbyists came to Albuquerque for the do.

Your guess is as good as mine as to how many terminals will be sold to handle some 44 million school children . . . 80 million homes . . . and perhaps 60 million workers who might need one. I'd say that it will be a large market . . . maybe 25 to 50 million terminals per year . . . plus peripherals such as memory, printers, etc. That would certainly come to 10 to 30 billion per year in sales. Not bad for a market that doesn't even exist today!

As long as the big computer firms don't notice this market, it will be wide open to the newcomer . . . and that means the computer hobbyist has a big advantage. Few others have the range of experience needed to get this new industry started . . . the hardware and software background combined. In five years the big manufacturers in the micro field may well be the small firms which are springing up today to provide hobbyists with equipment.

It is possible right now to develop a computer product and get into production with it for very little . . . and do well. Never has there been such an opportunity in the computer field for small businesses to start and grow. An investment of a couple of thousand dollars today could well launch a company worth over a million dollars in just a year or two.

Well, that's the message I thought the computer hobbyists and computer store owners might be interested to hear. Time will prove whether I am overly optimistic or not. My past predictions have come off well, so maybe I'll hit again.

PROGRAMS FOR SALE?

Newcomers to the computer field are sometimes surprised, once they have their system up and running, to find that all they have is machinery and the darned thing just sits there . . . not *doing* anything. Not that everyone hasn't heard of software and programs – it's just that many neophytes don't understand the tremendous importance of such.

Old hands are culpable in this, too, for they are generally familiar with a commercial or school system which came with software and, shucks, you can get all sorts of programs from the users groups . . . from libraries . . . no strain. Oh yeah?

Foreseeing this problem last year, I organized the Kansas City meeting of the microprocessor industry to form a standard cassette medium for program interchange. The meeting was difficult to get going . . . I had to get the site set up for it . . . send out letters to all involved . . . write it up in *Byte* . . . and then make an awful lot of phone calls to follow it up. The meeting, for which *Byte* has been given credit, was my idea and my doing . . . and the people who had taken over *Byte* were furious that I had set up the conference . . . they didn't want to be bothered.

So much for that.

So now we have a medium which can be used for entering programs into small computer systems. One thing which I think will help hobby computers and small business computer systems grow more than anything else will be a low cost plentiful supply of programs. I hope to provide same.

Here is the deal. I will buy programs from programmers and pay a good royalty on them. I will duplicate these and have them on sale in all of the computer stores around the country . . . and possibly in some of the more forward looking electronics distributors. I will have them carefully checked in my own lab to make sure that they work as advertised and that duplicates are perfect. We already have excellent tape duplicating equipment which we use for making the Morse code and radio theory cassettes we are presently selling . . . over 2500 a month.

If you are a programmer and have a good program available, please let me know. I need to know what it can do, what system it is for, and how much memory it takes. We will be able to check out programs on the Altair 8800 . . . have been promised a Sphere system . . . and hope to eventually have all other popular systems set up and running so we can check the programs.

What kind of programs can sell? Just about anything. I would expect we might have a cassette with five games on it which would go for $2.95. A real fine Star Trek program might go for $4.95. A payroll program for small businesses could go for perhaps $19.95. We would want to keep the prices down to where it would not be worthwhile to bootleg them or even make copies for friends . . . thus getting out from under the problem MITS has had with their BASIC, which apparently has been copied quite a bit.

Programmers would benefit substantially under this plan, since they would make 10% of the gross sales. Thus a $12 program would wholesale to computer stores for about $8 and the programmer would make an 80¢ royalty. This would mean $8,000 royalty for every 10,000 of the programs sold . . . and with several hundred thousand customers out there, if only 10% of them bought a given program this would mean a very nice return for the effort of writing and documenting the program.

These programs would be a bonanza for the stores . . . it would give them the ammunition they need to sell systems . . . not to mention that they might eventually be a good profit item in themselves as businesses and hobbyists come into the store to find out what new programs are available every week or so.

It is going to take this idea a while to get into motion. First we will have to get our own computer systems up and working . . . our experience has shown this not to be a minor undertaking. We have two computer techs and programmers on our staff right now and are looking for more. Then we will have to run thorough tests on cassettes to see which work best . . . using a computer to check each tape as it is made, comparing it, bit for bit, against the original.

Programmers . . . it's time to get working on your programs. Be sure to document them well . . . be sure you are not drawing on others' work . . . all our programs will be copyright . . . please put in some extra steps which are not needed, as a key to copyright infringement prosecution. We will need games . . . chess, backgammon, Star Trek, and so forth . . . business programs such as inventory, general ledger, accounts payable, accounts receivable, mailing list, and so forth. We will have to have a statement from you that your work is original.

Hopefully this system will provide the money to encourage programmers to work overtime to provide the software we need to sell small computer systems. By bringing a system to this presently chaotic aspect of computers, perhaps we can help the field to grow more rapidly.

Don Alexander WA8VNP and his RTTY station – winner of the grand prize in the MITS Altair demonstration contest. The home-built system consisted of an Altair 8800 with 8K of memory, an ASCII keyboard, a video display, Baudot teletype and Heath transmitter and receiver. Don also wrote the assembler and editor for the system, as well as the software to run the amateur station. The Altair did the Baudot/ASCII translation, cross-checked calls for duplication, and automatically sent the time and message number along with any text generated by the keyboard. After each contact, a logging entry was made on a model 26 teletypewriter. Don won a complete floppy disk system as the prize.

Here is John Craig, the editor of the I/O section of 73. John lives in Lompoc, California, where he is busy setting up some of the more popular microprocessor systems for evaluation.

ATTENTION, CLUBS!

One of the big problems for many club meetings is getting interesting material . . . so I've been watching out for interviews which I might get on tape which could be of interest to clubs.

The first tape I have available is an interview with Ed Roberts, the president of MITS . . . the first manufacturer of microprocessor kits to hit the jackpot. His Altair 8800 computer kit came out about a year and a half ago, just as MITS was in serious shape as a result of the plummeting prices in the calculator market. Their first year's sales of computers was about ten times what they estimated, and they are just now beginning to get caught up with events.

Ed's story is an interesting one, and it will give you a lot of insight into the manufacturer's side of things . . . it will also familiarize you a lot with the computer scene . . . what microcomputers are being used for and where the market seems to be going. Hear about some exciting technical developments which are coming.

The tape is on cassette only and is one hour long. It was made with top notch professional equipment, so the sound will be as good as your cassette player. Order Cassette Interview I . . . and never mind the usual prices for such tapes, normally around $12.95 . . . *73* is in the magazine business, not in the tape business, so your cost is only $3.95 postpaid.

This tape may also be of interest to repeater groups which run club bulletins and news of interest to members over the repeater.

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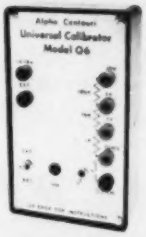

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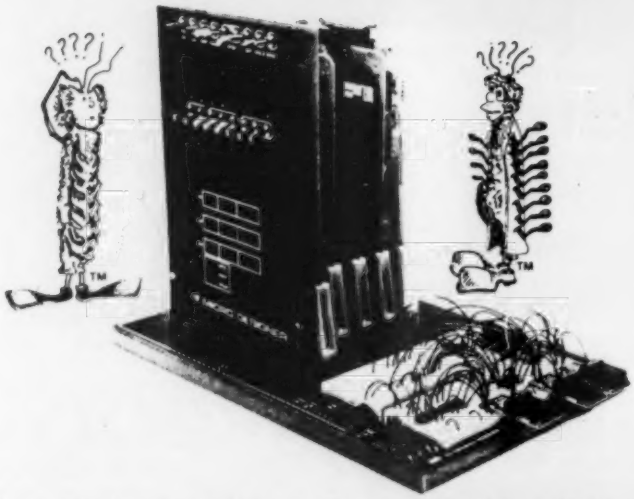

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Power Supply Testing

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The home computer hobbyist is frequently lured by advertisements for surplus power supplies and power supply kits of all kinds. These offerings range from excellent buys of surplus name-brand units, to units, both kit and assembled, of unknown pedigree.

Performance specifications of these units sometimes are not fully stated in the advertising, but name-brand units can sometimes be researched in the manufacturer's literature. The "orphans" can literally be almost anything, and some surplus dealers are, at best, only brokers. These dealers may not have the necessary equipment, time or interest to characterize surplus units they buy. Power supply kits may or may not have been carefully designed.

Where does this leave the computer hobbyist? Except for his purchase of name-brand units, he can be on a very shaky limb. Problems which might hit him can be one of three: complete failure, regulation failure, or the units may generate random and potentially harmful transients.

A complete failure is a nuisance at best and could be a costly disaster. The CPU can simply be shut down when the power supply quits, and few uP systems have power-fail programming to save the run. Here are two possible disaster scenarios: A series pass transistor shorts and dumps raw dc into the uP systems, destroying all or most of the parts. Or, some critical power supply part fails, starts a fire, and destroys the house. Although the latter is unlikely, even commercial computers have been known to catch fire.

Regulation failures can be explained as a condition where the regulator circuitry ceases to operate in its linear region, usually because the input voltage to the series pass element gets too low. Another problem can be thermal runaway if the unit has not been properly designed for continuous operation. A properly designed supply will protect itself and the load in case of shorts on the output.

The symptoms of regulator failure are low and unsteady output voltage, usually with high ripple feedthrough. The effect on the CPU depends upon which logic family is used in the system. CMOS will be least affected,

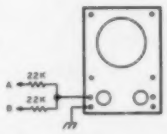

Fig. 1.

followed by MOS uP and support chips, and then TTL will be most affected. This non-linear regulator will also have higher than normal output impedance, which leads to coupling between fast logic elements. The uP system may drop an occasional bit, or become completely confused and lock up. Either way, the CPU is out of business.

Transients on the output come from the power line or are generated by an improperly designed power supply. Power line transients can usually be stopped by transient limiters on the power supply input, and

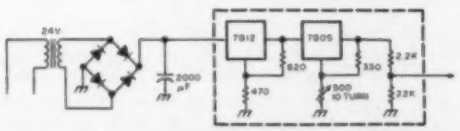

Fig. 2.

output spikes generated by the power supply can be caught by crowbar circuitry. But, if the crowbar has to fire, the CPU will still be shut down in mid-stride. Properly designed power supplies will not generate spikes under any condition of turn-on or turn-off. Of course, we all know that big spikes will kill any IC; we need to remember that small ones may cause improper system startup. Few home brew systems are designed and programmed for standby operation, but main supply shut-down spikes could also bollix the remaining active circuits.

Fortunately, power supplies can be screened for most of these possible defects, using relatively simple equipment. When investments of the magnitude required to own a home processor are concerned, it pays to screen all power supplies not furnished by the system manufacturer. If any home system manufacturer should be guilty of supplying inadequate power supplies, it is likely that the "computer grapevine" will get the word out promptly unless he corrects the problem. For those hobbyists who design their own units, remember that solid state power design is tricky, and even experienced designers test their prototypes thoroughly.

A modest amount of test equipment and two easily built gizmos will enable very extensive qualitative power supply testing accurate enough to assure the hobbyist of adequate and reliable performance from power supplies he uses. *Quantitative* testing, required mostly to prove one's prowess at power supply design, will require more and higher quality equipment. The test equipment needed is the following: a 20k Ohms/volt VOM, a variable autotransformer, a pulse generator, a very stable power supply, and an oscilloscope. The scope should be dual-trace with triggered, calibrated sweep, 5 MHz bandwidth and 10 millivolts sensitivity. The sensitivity and bandwidth are essential, and the triggered sweep will reduce frustrations during much of the testing. However, if a single-trace scope with the other qualifications is available, it is possible to get by with a couple of smart-aleck tricks. Fig. 1 shows how two signals can be mixed on one trace. This trick is good only on two low impedance sources, and it reduces the effective voltage of each signal to half its real value. In place of the calibrated sweep, let signal "A" be the signal to be timed, and signal "B" can be narrow pulses from a pulse generator with 1 kHz output. The resulting display will show 1 millisecond "tick" marks superimposed on signal "A." If the scope has a Z axis modulation input, the pulses can be used to intensify the trace as a time marker.

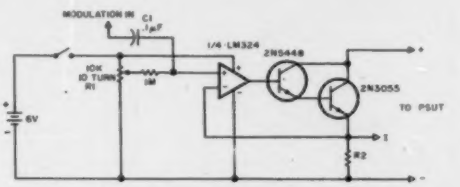

Fig. 3.

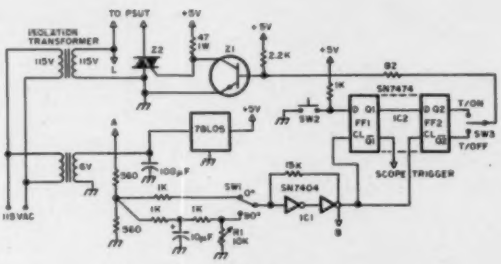

Fig. 4.

The power supply will be used as a comparison standard to check regulation and stability of the power supply under test (PSUT), so it must be much more stable than the PSUT. If there is the slightest doubt, Fig. 2 shows a circuit suitable for a reference supply. All parts inside the dashed line should be built inside a thermally insulated box and the supply should be allowed to run continuously for best stability. The output will vary from below 5 volts to around 18 volts, which should cover all supplies of interest to the computer hobbyist. The other equipment is very common, and the applications discussed below will explain their use.

The first special gizmo is a dynamic load — a circuit which simulates the type of load fast logic places on a

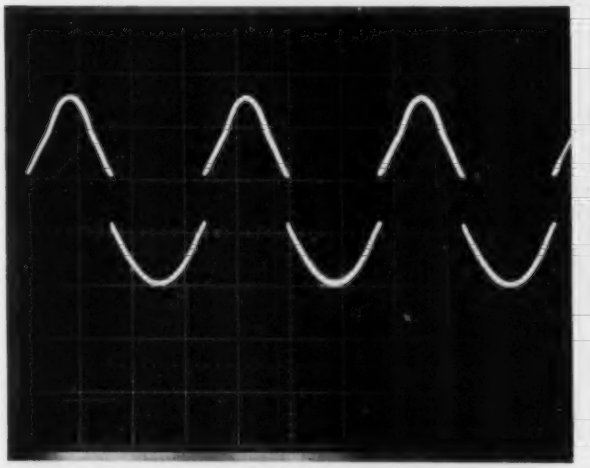

Fig. 5a. Mixed waveforms from circuit of Fig. 4 showing trigger at zero crossing of line voltage.

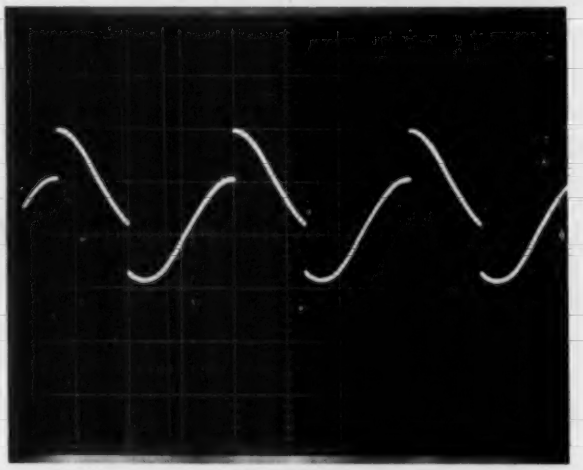

Fig. 5b. Mixed waveforms showing proper adjustment of R1 so IC1 triggers at line voltage peak.

Fig. 6.

power supply. Fig. 3 shows the circuit; R1 sets the load current drawn from the power supply for any given value of R2. R2 is chosen to give about one volt output at the maximum load current to be drawn from the PSUT. C1 is an input from a pulse generator which causes the load current to increase sharply then decrease, varying over a small range. Because Q2 and R2 dissipate the entire power output of the PSUT, both should be mounted on a large heat sink.

The second gizmo allows a power supply to be switched on or off at a special time – either at line voltage zero crossing or at line voltage peak. If the PSUT will develop spikes at turn-on or turn-off, close examination of the PSUT output using an oscilloscope will reveal the problem. Fig. 4 shows the circuit; it is safer to observe the special precaution of using an isolation transformer. If such a transformer is not available, take strict precautions to insure, by measuring both circuit common and point "L" to a good earth ground, that circuit common is really the low side of the line. Circuit operation is simple; IC1 samples the transformer output and produces approximately a square wave. With SW1 in the 0° position, the rising edge of the waveform at "B" will occur at zero crossing. With SW1 in the 90° position, R1 can be adjusted so the trigger occurs at line voltage peak. The photos in Fig. 5 show the mixed waveforms (see Fig. 1) for zero crossing (Fig. 5a) and for switching at line peak (Fig. 5b). IC2 consists of two flip flops which are clocked by the output from IC1. If SW2 is open, Q1 and Q2 are both high; with SW3 in the T/ON position, Z1 is turned on and triac Z2 is turned off. When SW2 is closed, Q1 goes low on the next positive edge from IC1, and Q1 triggers the scope. On the second positive edge from IC1, Q2 goes low and Z1 turns off. Z2 is then turned on by current through the 47 Ohm resistor and any load connected to Z2 is activated. After R1 has been adjusted properly, the load can be switched at zero crossing or line peak by setting SW1 and closing SW2. With SW3 in the T/OFF position, Z2's load is activated until SW2 is closed, then Z2 turns off at the next zero crossing after FF2 switches.

Three types of tests should be performed on all unknown power supplies to give reasonable assurance of safe, reliable operation in a home computer system. These are: (1) transient detection and rate of rise; (2) dc regulation and heat rise; and (3) output impedance.

As mentioned above, power supply transients can disrupt or damage the CPU. In a computer system which uses several different voltages, sections of the system may lock up or be damaged if (for example) the +15 volt bus comes up before the –5 volt bus. The rate of rise measurement allows the system designer to know if all supplies will come up together when switched by the same power switch.

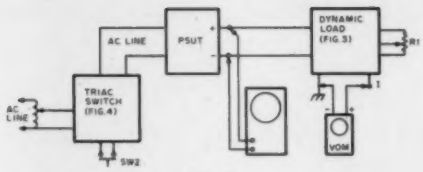

Fig. 9.

The dc regulation test tells how well the regulator circuitry performs, and the heat rise test forewarns of possible fire or overheat conditions if the supply is used for continuous operation.

A test of power supply impedance tells how well the supply will decouple possible circuit interactions. A noisy Vcc line can be very bad for TTL logic and may cause subtle problems almost impossible to locate without a very good oscilloscope. Although decoupling on the board is helpful, it will not entirely overcome the effect of a high impedance power supply. Probably 90% of all decoupling would not be needed if a "perfect" (zero output impedance) supply were available. *However:* A "perfect" power supply feeding a load with 2' of #24 wire clip leads might have over an Ohm of impedance for fast logic signals.

Fig. 6 shows typical output connections for a modular, fixed voltage supply which does not have sense lines. Any stated performance specifications (% regulation, noise, ripple, etc.) apply *only* at those terminals. They will still be very close if the supply feeds a load via #8 wire leads. If the supply is feeding a home brew backplane wire wrapped with #30 wire, the top of the card 12 slots away may be in trouble!

Some of the connecting lead problems go away if the supply has sense leads as shown in Fig. 7. Sense leads must connect electrically as shown in Fig. 7a. If this connection is made physically at the supply, the equivalent circuit is the same as Fig. 6. If both the sense leads and load leads attach at the load as shown in Fig. 7b, the published specs now apply at the load.

Power supply test hookups must be carefully and properly made! Fig. 8 shows right and wrong connections – note that the "wrong" connection includes the effect of the load leads and the drop across the ammeter in the measurement. If you want to prove the importance of heavy power supply leads, repeat some of the tests outlined below using the "wrong" connection and #30 wire and check the difference.

Do the transient test first and discard or redesign any unit which fails. Use the triac switch of Fig. 4 with the connections shown in Fig. 9. *Remember the grounding precautions if an isolation transformer is not used.* With SW3 set to T/ON and SW1 set to 0°, sync the scope so the rising output of the PSUT is displayed on the scope as in Figs. 10a and 10b. Repeat the test for T/OFF (Fig. 10d) and repeat the T/ON test with SW1 set to 90° (Fig. 10c). OK the PSUT only if no spiking occurs under low, medium and full load conditions. If rate of rise is important to your system, measure it before dismantling the test setup. The PSUT shown in Fig. 10 was a surplus supply with a good pedigree; it is

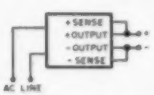

Fig. 7a.

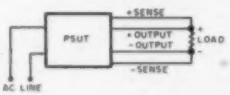

Fig. 7b

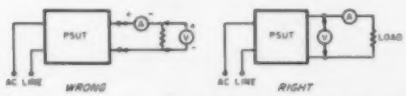

Fig. 8.

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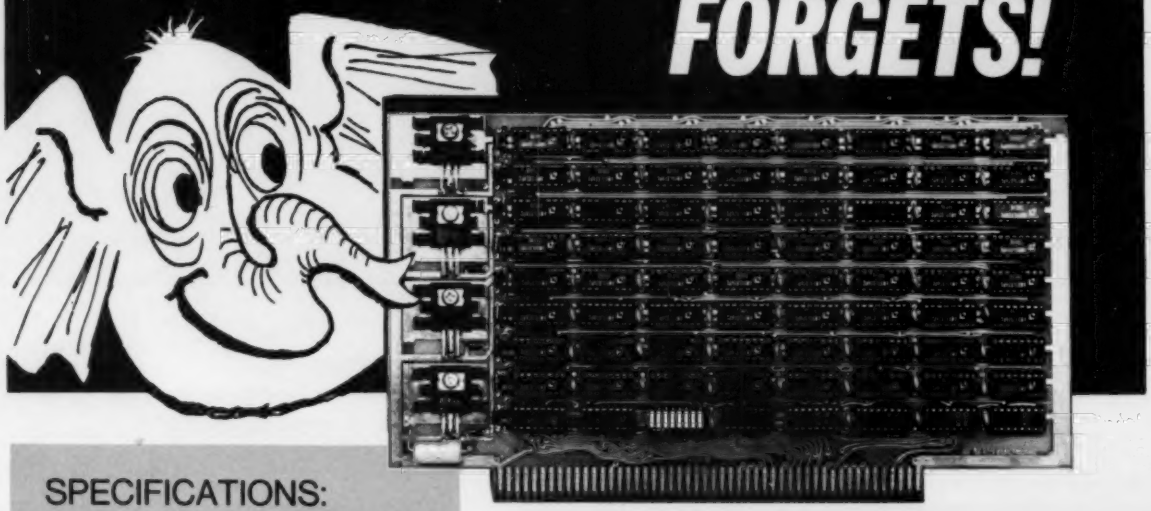

SPECIFICATIONS:

8K SC-8 Specifications:

Access Time:	500 ns Max. (225 max on request)
Current Req:	Less than 200 ma per 1024 words maximum
Memory Chip:	AMD 91L02 APC **(low** power 1K x 1)
Voltage Supply:	+5 to +10 volts
Battery Standby:	1.5 to 2 Volt, Automatic power loss sensing circuit. Eliminates need for switches.
Address Select:	8 ea. Spst. switches in a Dip IC package. (No longer any need for a soldering iron to change address.)
+5 Volt regulated:	4 ea. 7805 regulators with individual heat sinks to run cooler.
Wait States:	NONE! Your wait light will not burn because of a memory wait state.

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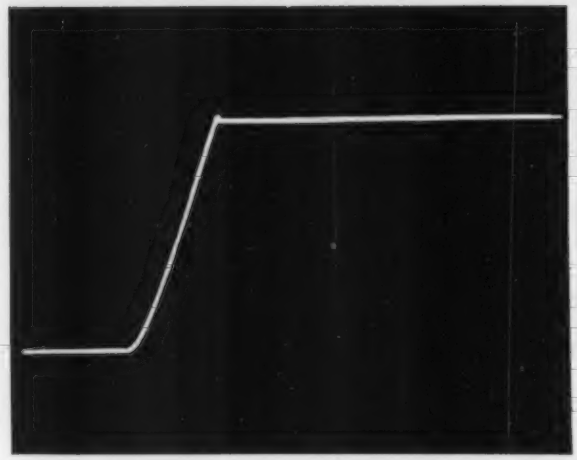

Fig. 10a. Turn-on of 5 V, 3 A power supply; 1.8 A load, switched at line voltage zero crossing. Time of rise — 3 milliseconds. Note rapid response to very minor overshoot.

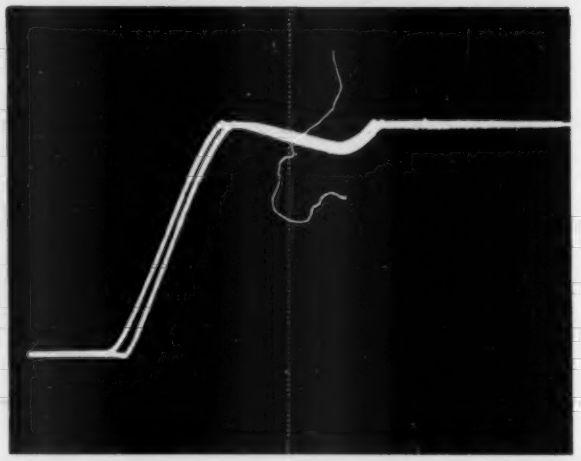

Fig. 10b. Double exposure of 5 V, 3 A power supply; 1.8 A load, zero crossing turn-on. Voltage irregularity caused by incomplete charging of filter cap on first cycle of line voltage. Note that voltage does not exceed set value more than 1%. Excellent regulator!

very gratifying to have such excellent test results from a supply which cost about half the going rate!

Set up the regulation test as shown in Fig. 11. Select R2 of the dynamic load (Fig. 3) for one volt drop at full rated load current of the PSUT, then read current with the VOM at output I. For example, if R2 is 1 Ohm, one Amp will give one volt across R2. Set the line voltage to 115 volts and set the reference supply to the same output voltage as the PSUT. Let the whole system warm up at 50% load (PSUT rating), then connect the VOM with the resistive network shown in Fig. 11. Set the VOM to the 50 microamp scale and adjust the reference supply so the meter reads zero. Close SW4 and readjust the reference supply for mid-scale on the meter. Now, 50 millivolts change in PSUT output will swing the meter to end scale. Lower the line voltage to 105 volts, note the VOM reading after one minute, then raise the line to 125 volts and note the change after one minute.

Percentage regulation is defined as

$$\frac{VH - VL}{VH} \times 100\%,$$

where VH is PSUT output at high line and VL is PSUT output at low line. Since this connection will measure the change in output, this reduces to the VOM reading in millivolts divided by the output voltage set on PSUT (an approximation, unless a digital voltmeter is available to measure VH). For 100 millivolts change (full scale swing on the VOM with SW4 closed) on a 5 volt supply, the % regulation is .1/5 or 2%. This is a "not good" unless the impedance test gives exceptionally good results. Even so, such poor regulation on a supply sold as a "regulated" supply may mean the regulator circuit has problems.

Repeat the test with line voltage fixed at 115 volts and change the load from no load to full load. Compute the regulation as before, using the change in output voltage as measured by the VOM and the nominal output voltage of the PSUT. Acceptable regula-

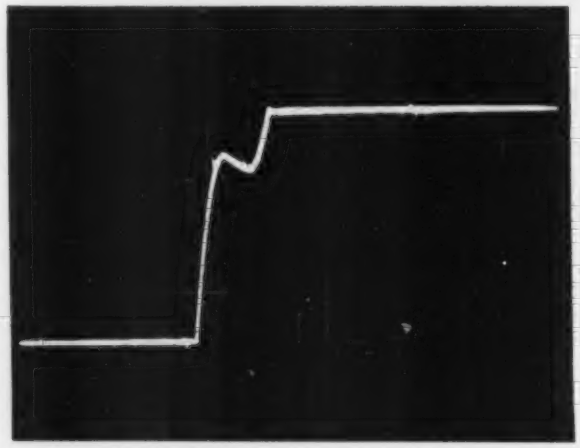

Fig. 10c. Turn-on of 5 V, 3 A power supply; 1.8 A load, turn-on at line peak.

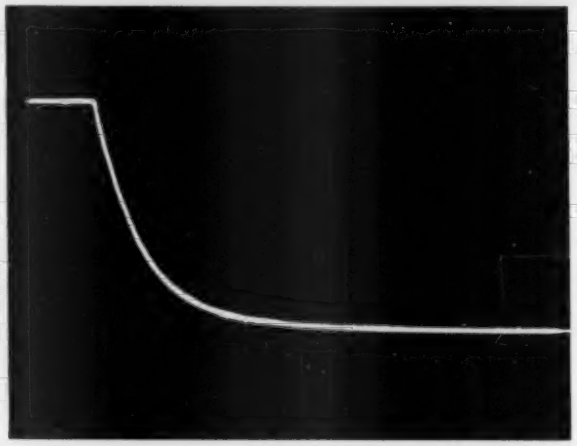

Fig. 10d. Turn-off of 5 V, 3 A power supply with 1.8 A load; total decay time — 150 milliseconds. Note complete absence of transients.

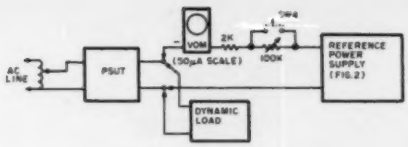

Fig. 11.

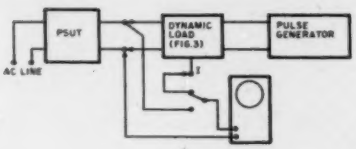

Fig. 12.

tion is .2% (10 millivolts change on a 5 volt supply), but .1% is better for most applications. For that supply with poor line regulation, repeat the no load/full load test at low line voltage and reject it for long-term use if the regulation changes substantially at low line voltage.

Run the heat test by pulling full load for several hours. The PSUT output should change very little, and no part of the supply should become too hot to touch. If the heat rise is too much or the regulation changes drastically, reserve the unit for smaller loads or intermittent duty. Sometimes it is possible to add heat sinks to overheating supplies, but heat-flow design is beyond the scope of this article.

The output impedance test also uses the variable load. In this case, set some mid-range load on PSUT, then feed a small amplitude square wave or pulse to the modulation input. Use the scope to monitor the I terminal on the variable load, and set the modulation drive so the current is changed by 10% of the fixed load current. Then move the scope to the PSUT output and look for output voltage changes at the modulation frequency. Measure both the current change and output change in voltage peak-to-peak and divide the voltage change by the current change. Output impedance is simply this voltage divided by the current. For example, assume the load current is 1 Amp, with a current change of .1 volt peak-to-peak. If the PSUT output changes by .01 volt peak-to-peak, the impedance is .01/.1 or .1 Ohm, a good value. Vary the pulse frequency over a fairly wide range to check for any major change in impedance. Most solid state supplies of good design will hold output impedance essentially constant over a wide frequency range.

Now that you have located a good supply with low impedance, don't handicap it! Run bus *bars* for power lines instead of wires, solder power connections everywhere except where they pass through connectors, use high quality connectors and choose or lay out PC boards with wide, multiple power runs. Even if the logic card draws fairly low power, fast logic generates fast transients. Small power conductors are inductive at much lower frequencies than large, flat conductors. Inductance in a power bus encourages interstage coupling, which spells *trouble* in any computer.

Power supply testing is so important that all computer hobby club members who home brew equipment should pool their resources to assemble a good test facility, then help each other check out all their power supplies. ■

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A RTTY/Computer Display Unit

--Baudot, ASCII, TTL, RS232, etc., etc.

In order to interface man with computer, some sort of input/output device is needed. An extremely versatile output device is a visual display unit, which displays data on any modified television screen.

The display unit described in this article is very efficient, both in price and in the density of the data on the screen. It displays 25 lines of 40 characters each on the screen – almost double the density of most other display units now on the market. And the parts cost is less than $100.00, buying from companies advertising in the back of this and other electronics magazines, including the price of the double-sided, plated-through board. All display unit parts, including the $20 power supply, are contained on one 7.2" x 11.4" board. The option boards are both about 4" x 4".

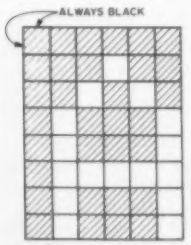


Fig. 1.

The two option boards that are available are used to input serial ASCII and serial Baudot. The first accepts the serial ASCII, converts it to parallel, and enters it into the display unit's memory. It also accepts parallel data from a keyboard, etc., and serializes it. The serial interfaces can be either TTL, EIA RS-232C, or 20 mil loop compatible, all selected by two jumpers. The other option accepts serial Baudot code, converts it to parallel, and changes the code to ASCII. This ASCII data is then sent to the display unit. The inputs to the Baudot board can be either TTL, EIA RS232C, or 60 mil loop.

A useful feature of the display unit is called next line blanking. This causes the screen to be erased, line by line, as the cursor moves down a page full of data. If this feature was not in the display unit, after the screen had been filled with data once, you would simply be writing over old data, character by character. To say the least, this can be very confusing! Full cursor control is available using the "forward/backward" input. The cursor can be moved straight up or down, left or right, or to the left of the screen, and then up or down one line. A self-test line is available so that signals can be displayed on the screen; therefore, in most cases, an oscilloscope is not needed. All logic is done with standard TTL gates and dividers. There are no capacitively coupled lines or other bears to troubleshoot, so a person with a modest experience with logic will probably be able to easily fix his board, should it not work.

Basic Information

The 3320 display unit has a format of 25 lines consisting of 40 characters each. The characters are arranged in a standard 5 x 7 matrix, each space in the matrix being either a white or a black dot on the screen of the television. There is a one dot space both horizontally and vertically which is always

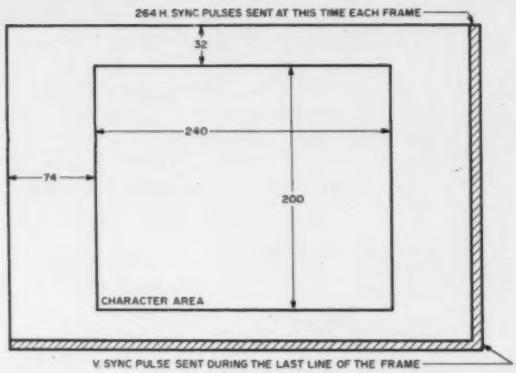


Fig. 2.

black to make sure that there is space between characters. Therefore, each character takes up a space of 6 x 8 dots on the screen, as shown in Fig. 1 for the letter "A". Each dot represents one cycle of the master clock.

The cursor, or the marker showing the next character position, is a white line five dots wide on the top scan line of that character, which is otherwise always black. The cursor flashes at a rate of two times per second to aid in finding it in a crowded screen.

Since characters take up 6 x 8 dots, and there are 40 characters on each of the 25 lines, there is a display area of 240 x 200 dots. There are provisions in the timing chain, however, for 384 x 264 dots. The reason for this is that the television's beam scans past the edge of the screen, where you can't see it. When it is well past the visible area on the screen, a horizontal or vertical sync pulse is sent which causes the beam to go back to the left edge or to the top of the screen, respectively. The display is centered within the 384 x 264 dot matrix, and fills up the visible screen of most television sets. This arrangement is shown in Fig. 2.

To interface the unit with the outside world, a parallel input and video output are provided. The input consists of seven data lines coded in ASCII, along with a strobe line. The strobe line is used to tell the display unit when to enter the data. When the strobe line makes its transition (either positive or negative, jumper selectable), the data is entered into memory. This strobe line is de-bounced on the board, and a strobe received pulse is available at the output connector. This is used by the input options and is required by some types of keyboards. The video output is a 2.25 V P-P signal with the specifications shown in Fig. 3.

Timing

The schematic diagram for the timing chain is shown in Fig. 16, while the timing chain is shown in Fig. 15.

All timing is derived from a crystal-controlled oscillator whose frequency is 6.082560 MHz. The output of this oscillator is called the A clock, and is fed into various dividers until it finally reaches the T clock, being 60 Hz.

The B clock is exactly half of the master clock, since it goes through the first flip flop in the divider chain. The C, D, and E clocks are all of the same frequency, but are different in phase. Since characters are six dots wide, there are six A clock pulses, three B clock pulses, and one each C, D, and E clock pulses. This is shown in Fig. 4 for the top of the letter "A".

The F clock is half of the D clock, and from the G to the J clocks, the previous clock is divided by two to get the present one.

The K clock is special, however. It is low when characters can be printed across the line and goes high when they can't (during horizontal retrace). There are enough clock pulses for 64 characters on a line, but only 40 of these are used. The extra 24 character positions cannot be displayed on most television sets, anyway, and are used for horizontal retrace. The K clock is not the output of a flip flop, but rather a latch that gets set on the 41st character and reset on the first character. In the middle of retrace (when the I clock is low), a horizontal sync pulse is created. This tells the television to send the electron beam back to the left side of the screen so that a new scan line can begin.

The K clock is divided by two, four and eight to get the L, M, and N clocks, respectively. These three clocks are fed to the character generator to tell it which scan line of the character the television is displaying. This is shown in Fig. 5 for the left side of the letter "A".

Note that the top scan line is always blank. This is to provide vertical spacing between characters, and to allow time for 40 characters of the page memory to be moved into the line memory.

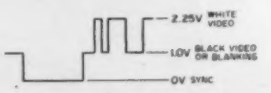


Fig. 3.

This is explained in detail in the memory section.

The last six clocks are different because they are reset at the end of the frame. There are provisions for 264 scan lines per frame (33 character lines of eight scan lines each). Since all dividers must be synchronized with each other, all affected counters are reset at the end of the frame, and the whole timing chain starts over.

As was mentioned earlier, there are provisions for 33 character lines, but only 25 of them are used. The T clock is low when characters can be vertically printed on the screen, and high when they can't (during vertical retrace). The T clock is like the K clock, in that it is a set/reset flip flop arranged as two cross-coupled NOR gates. The flip flop is set on the 26th line and reset on the first. In the middle of vertical retrace, the vertical sync pulse is created, telling the television's electron beam to go to the upper left hand corner of the screen and start a new frame. Several other timing pulses are derived from the lettered clock pulses, and they are explained in the cursor control and memory sections.

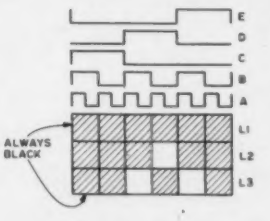


Fig. 4.

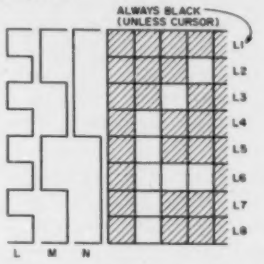


Fig. 5.

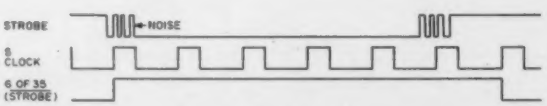


Fig. 6.

Bits b7 b6 b5	0_0	0_1	0_2	0_3	1_0	1_1	1_2	1_3
b4 b3 b2 b1 (Row ↓ / Column →)	0	1	2	3	4	5	6	7
0 0 0 0	0	NUL	DLE	SP	0	@	P	\	p
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0	2	STX	DC2	"	2	B	R	b	r
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w
1 0 0 0	8	BS	CAN	(	8	H	X	h	x
1 0 0 1	9	HT	EM	)	9	I	Y	i	y
1 0 1 0	10	LF	SUB	*	:	J	Z	j	z
1 0 1 1	11	VT	ESC	+	;	K	[	k	
1 1 0 0	12	FF	FS	,	<	L	\	l	|
1 1 0 1	13	CR	GS	-	=	M	]	m	}
1 1 1 0	14	SO	RS	.	>	N	^	n	~
1 1 1 1	15	SI	US	/	?	O	—	o	DEL

ENQ – Enquiry
ACK – Acknowledge
BEL – Bell
BS – Back space
HT – Horizontal tab
NUL – Null
SOH – Start of heading
STX – Start of text
ETX – End of text
EOT – End of transmission
ETB – End of transmission block
CAN – Cancel
EM – End of media
SUB – Substitute
ESC – Escape
SI – Shift in
DLE – Data link escape
DC1-DC4 – Device controls
NAK – Negative acknowledge
SYN – Synchronize
FS – File separator
GS – Group separator
RS – Record separator
US – Unit separator
LF – Line feed
VT – Vertical tab
FF – Form feed
CR – Carriage return
SO – Shift out

Fig. 7.

Memory

The memory schematics are shown in Fig. 19.

There are two clocks associated with the page (hex-1024 bit) memory, and one more is created for the line (hex-40 bit) memory. The main memory clocks are labeled Ø1 and Ø2, Ø1 being the output clock and Ø2 being the input clock. For every character that is shifted, both clocks have to be sent to the shift registers. These two clocks have to swing from +5 to -12, which are not standard TTL levels, and must not overlap. There is a clock driver between the timing chain and the memory to buffer these clocks. Since there are 1024 positions in the shift register, but only 1000 are used to display data, 24 extra clocks must be added somewhere in the frame.

These extra 24 pulses begin at the rise of the T clock, and end after 24 pulses have been counted by circuits 21, 13, and 22. These 24 pulses are logically ORed with the 1000 pulses that occur normally. The 1000 pulses occur during the scan line that is always black on the screen (L1), and only in the character area (the 240x200 dot area where characters are displayed). There are 40 of each clock per character line, where a character line consists of eight scan lines.

The line memory is clocked by the line clock which comes 40 times per scan line. During the top scan line of a character line (L1), the page memories are being clocked out, and that data is being clocked into the line memory. The data that was in the line memory is sent to the character generator, but since it is scan line number one, the output of the character generator is all zeros. On the next seven scan lines the data just fed into the line memory is clocked into the character generator over and over again.

The character generator is actually a read only memory that is addressed by the output of the line memory and the L, M, and N clocks which tell it which scan line the unit is now displaying. The output for the first scan line (L, M, N = 0) is always zeros, so the top scan line always is black. The output for the second scan line of the letter "A" would be 00100, the one being the point on the top of the letter.

The output of the character generator is sent to a shift register, which shifts the data out at the frequency of the A clock. The serial input of this output register is grounded so that during retrace its output is low, making black dots on the screen. The character generator's output is loaded into the output register when $\overline{load}$ is low and the A clock rises. Note that the first load pulse is created one character position after the other memory clocks start. This is because there is a long propagation delay between the page memory's and the character generator's outputs. The output of the shift register is sent to a buffer transistor where it is mixed with the sync pulses and is sent to the television.

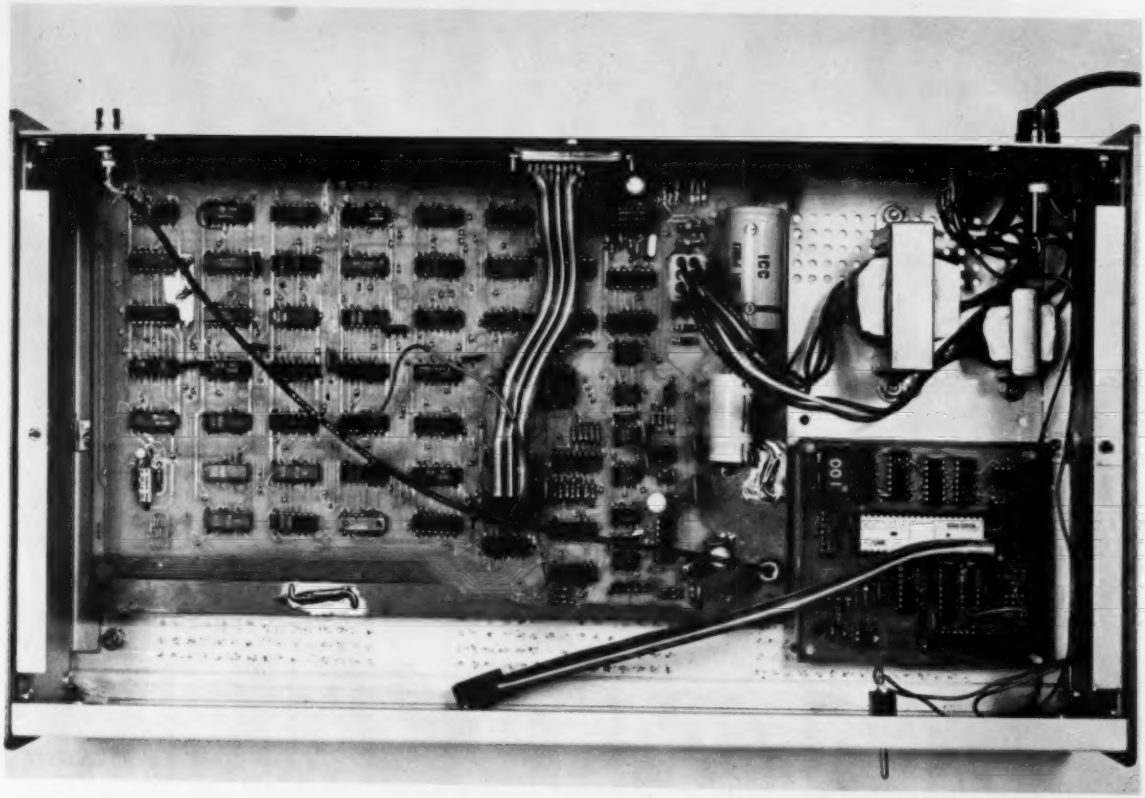
Input Conditioning

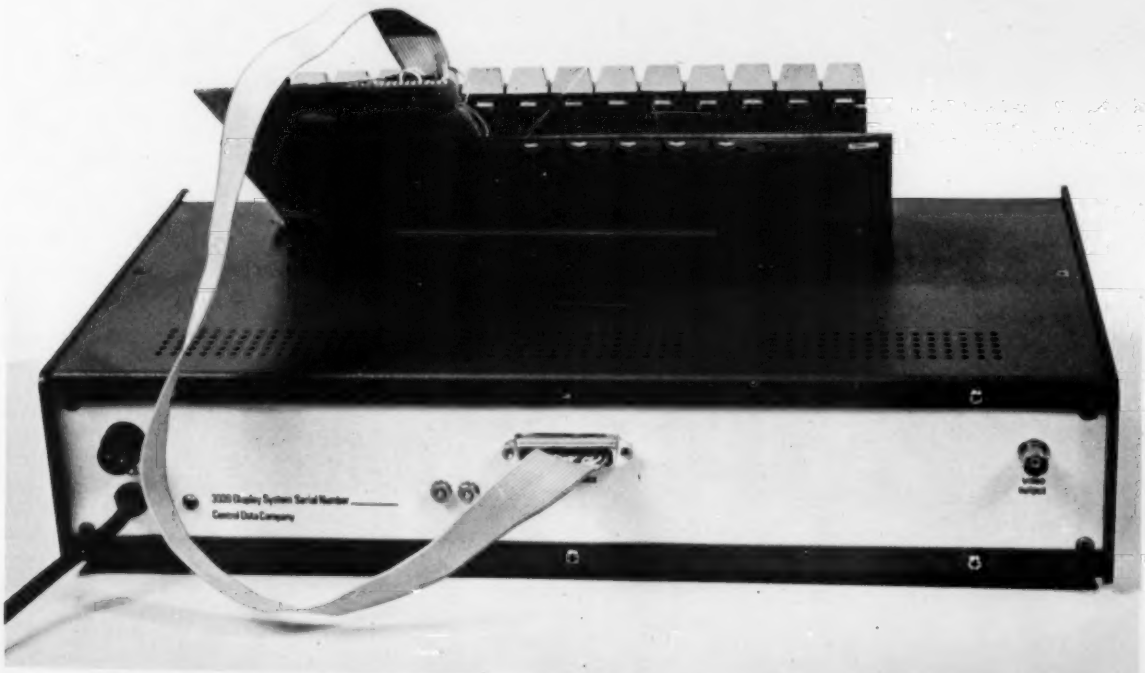
The input conditioning and cursor control schematics can be found in Fig. 17.

In order to enter the input data into the memory, it is required that a strobe pulse accompany the data. This pulse can be either negative or positive going, depending on the wiring of the strobe jumper. If it is a negative strobe, points A and C are jumpered as explained on the cursor control drawing.

The de-bouncer is the first type D flip flop in the chain. After strobe is received (pin 2 of 35 goes low), the device waits for the next rise of the S clock. When this happens, the output (pin 6) goes high. The reason that this circuit de-bounces is that the S clock has a period longer than any noise on the strobe pulse could last.

The sequence of events is shown in Fig. 6. Pin 6 of 35 is sent to the clock of the next flip flop. When it goes high, the grounded input is transferred to the output (pin 9), and that sets the NAND gate set/reset flip flop. When this flip flop's Q output (pin 8) goes high, its $\overline{Q}$ output goes low, running back through an AND gate and setting the second type D flip flop. Even though pin 9 of 35 now goes high, the set/reset flip flop stays set (pin 8 stays high). That output is sent to the input of another type D flip flop whose clock is the $\overline{T}$ clock. Therefore, when $\overline{T}$ goes high, pin 5 of 36 goes high and 6 of 36 goes low. Pin 6 of 36 is fed back to reset the set/reset flip flop, bringing pin 8 of 17 low. The next time the $\overline{T}$ clock rises, pins 5 and 6 will go back to





their normal states. Pin 5, therefore, goes high for exactly one cycle of the timing chain. The clear line sets the second and third type D flip flops to the correct states.

Pin 5 of 36 is sent to different parts of the cursor control section depending on the setting of the control bits. If bits 6 and 7 of the input data are not both low, a standard update cycle begins. This is where the input data is put into memory and the cursor is moved one position forward or backward. If, however, bits 6 and 7 of the input data are both low, a line feed (LF) cycle begins. If an LF cycle happens with bit one low, then a line feed is initiated (the cursor moves straight up or down one line).

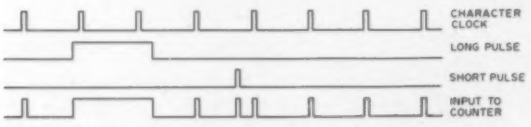


Fig. 8.

If bit one is high during an LF cycle, the cursor moves back to the beginning of the line, and then up or down one line. In this case, a set to 40 pulse is created at pin 11 of 38 since bits 6 and 7 are both low (1 of 37 is high) and bit one is high. This status is ANDed with the up or down pulse (only created during an LF cycle) to arrive at the set pulse. The any cycle line is hooked directly to pin 5 of 36, so it goes high for one cycle after strobe drops no matter how any of the data bits are set. Fig. 7 shows the ASCII codes as used in the 3320 display unit.

Cursor Control

The cursor control section can be thought of as a chain of flip flops that divide their input by 1000. The clock for this divider sends a pulse during the first scan line (L1), above where each character could be. The divider is actually a divide by 40 chain placed in front of a divide by 25 chain. Since the total chain divides by 1000, and 1000 clock pulses are created each frame, the output of the last stage of the divider will drop once each frame. When this output drops, the cursor is displayed on the screen.

To move the position of the cursor, the divider must drop at a different time in the frame. This can be accomplished since the input of the divider can receive pulses from either the character clock generator or a special circuit that either adds or takes away pulses.

If an extra pulse is fed to the divider, the output will drop one character earlier. If a pulse is taken away, the output will drop later, since it will take longer to count 1000 pulses. Instead of taking away pulses, a long pulse is created that "covers" two normal pulses, as shown in Fig. 8. So if we want to move the cursor back one position, an extra pulse is added between the normal character clock pulses. If we want to move the cursor ahead one position, we cover up two pulses by adding one long pulse. The pulse, whether short or long, is created when the update cycle drops, setting pin 9 of 22 high. Pin 9 of 22 goes low the next time that the E clock rises, and will stay low until the update cycle drops again. If the FWD/BKWD line is high, this pulse goes through an AND gate to set a set/reset flip flop, IC23. The next time that the G clock goes high, the set/reset flip flop gets reset. This flip flop, therefore, stays set for the first two character positions of the frame. The output of this flip flop is called the forward pulse.

When pin 9 of 22 is high, an A clock pulse is sent through an AND gate to pin 12 of 20. This pulse is called the backward pulse. Even though it seems that two pulses would come out of this gate each update cycle, only one does. This is because there is a propagation delay between the A clock and the T clock. Because of this small delay, the T clock (and the update cycle) drop in the middle of the first C clock of the frame. Therefore, the very first A clock pulse of the frame does not get through to pin 12 of 20, but the second one does. By the time that the third A clock pulse comes, pin 9 of 22 has been reset to 0. The one short pulse that does get through is called the backward pulse.

The character clock, forward pulse, and backward pulse are all ORed together to form the input to the divide by 40 chain. If there wasn't just an update cycle, only character clock pulses get through. If there was just an update cycle and the FWD/BKWD line is low, the backward pulse will also get to the clock of the divider. This will clock the divider one extra time, so its output will drop one position earlier. If there was just an update cycle, and the FWD/BKWD line is high, the forward pulse gets through and covers the first two character clock pulses as well as the backward pulse. There is one less clock pulse this frame, so the divider drops later.

The divide by 40 chain consists of circuits 30 and 31, and its output is pin 11 of 31. When this output drops, it clocks pin 6 of 32, setting pin 11 to a low state. On the next character clock pulse this flip flop is set (pin 11 goes high) and stays that way until the counter drops again.

The divide by 25 chain operates the same way that the divide by 40 chain does, as far as adding pulses to move the cursor. To move the cursor up, an extra pulse is added, making the divider drop one line earlier. If the cursor is to move down, a long pulse is created to cover up two normal pulses. The normal clock to this divider is pin 11 of 32, which goes through IC28 to get to the divider (circuits 33 and 34). The dropping of the LF cycle line sets off the extra pulse generators in the divide by 25 counter chain. It sets pin 12 of 24 high, but that pin is soon reset when the E clock rises. If the FWD/BKWD line is high, the pulse from this flip flop goes through an AND gate and sets a flip flop, circuit 27. The $\overline{Q}$ output (pin 4) of this flip flop goes low immediately and rises again when the P clock goes high. The $\overline{Q}$ output of this flip flop is therefore low for two character lines (16 scan lines), and is called the down pulse. Pin 12 of 24 also is ANDed with the A clock to create a short pulse (the up pulse). The reason two pulses are not created is the same as was explained for the divide by 40 chain.

The up and down pulses, along with the normal clock from pin 11 of 32, are run through an AND gate and sent to the clock input of the divider. If a line feed cycle has just happened, and the FWD/BKWD line is low, the short pulse from pin 12 of 26 is added on to the normal clock pulses, causing the cursor to come one line earlier. If the FWD/BKWD line is high, the long pulse from pin 4 of 27 covers the first two normal clock pulses and the up pulse. Note that the up and backward pulses come even if the FWD/BKWD line is high, since they will be blocked out by the down and forward pulses anyway.

The divide by 25 chain consists of circuits 33 and 34, and its output is pin 11 of 34. This output is the clock input

to a J-K flip flop, pin 1 of 32. When the output of the counter drops, the flip flop changes states, and pin 14 of 32 goes high. This flip flop is reset by the next character clock pulse, so pin 14 of 32 goes high for only one character width.

This line is called character position and goes to the chip enable of the character generator, which causes the generator's output to go high (display white on the screen). This is the cursor, and it goes to a blinker circuit before it gets to the character generator, which switches it off and on at the rate of about two times per second.

The character position line is ANDed with the update cycle and that pulse is sent to the page memory location that it is now at. The memory therefore gets changed during the update cycle, while the position of the cursor gets changed during the frame immediately following the update cycle.

To clear the display and move the cursor to the upper right hand position of the screen, the clear line is brought high. This brings the write line of the page memory high. It also brings the input to the memory bit 6 high. All keyboard data is gated to the memory inputs only when the update cycle is high, so the other five data inputs will be low. The ASCII code for a space is all bits low except for bit 6. So what will happen is that the memory will take the input data (space) and keep putting it into memory until the clear line goes low. If the clear line was high long enough to allow all of the memory positions to be accessed (1/60 second), the memory will be filled with blanks.

Now that the screen is blank, the cursor has to be moved to the first position of the page. To do this, both of the cursor divider chains are set to all ones; on the next clock pulse the divider's

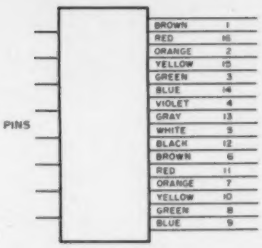


Fig. 9.

outputs will drop, displaying the cursor. A set/reset flip flop is set when clear goes high, and its output (pin 13 of 27) is used to preset the divider chain. Since the first clock pulse that gets to the divider must be at the beginning of the frame (so the counter will drop after the first clock pulse, or in the first character position), the preset line must go back to its normal state at the beginning of the frame. The preset line goes low the first time that the $\overline{T}$ clock goes low, after clear drops. Since the $\overline{T}$ clock goes low at the beginning of the frame, so does the preset pulse, and the dividers are now clocked.

Next Line Blanking

The next line blanking schematic can be found in Fig. 18.

The next line blanking circuit makes sure that, after you fill the screen and are about to start writing over old information, old information gets erased. It clears the screen line by line, as the cursor moves downward.

The lines get "blanked" under the following two conditions:

1. If the cursor is detected in the first character position of a line. In this case, the line that the cursor is on gets filled with blanks.

2. If a line feed is initiated. (The cursor moves straight down.) In this case, the line below the cursor's gets filled with blanks. Therefore, after the line feed is finished, the cursor is on the blank line.

To find whether or not the cursor is in the first position of any line, character position is ANDed with a signal that is high only in the first position of each line. This signal is pin 12 of 40, which is a J-K flip flop that gets set at the beginning of a line and reset after the first character position of the line is passed. Since the first load pulse lags behind the first line clock pulse by one character (as explained in the memory section), when both of these are high, and we are in the character area, we are also in the first position of a line.

As was stated earlier, this pulse is ANDed with character position, and if it is not "any cycle" or the frame right after it, it is used to set a flip flop (circuit 43). This flip flop's output (pin 13) is reset to zero the next time the K clock goes high (at the end of the scan line). This line goes on to bring the write line of the memory high, along with the bit 6 input, so that the memory gets filled with spaces. Since this line goes high at the beginning of a scan line and drops at the end of it, 40 locations of memory get filled with spaces. The memory gets written with spaces every cycle that the cursor is in position one.

In the second case, if an LF cycle occurs, it is ANDed with character position to set a flip flop (circuit 43). This will bring pin 4 of 43 high, and will allow the next flip flop (circuit 24) to toggle. This will happen the next time the N clock drops, or at the beginning of the next character line. This pulse is fed back to the first flip flop and resets it. The line is reset the next time that horizontal sync goes low. Therefore, the line goes high for almost one scan line, on the character line below the line where the cursor now is. (Remember that the cursor moves after an LF cycle drops.) This line also is fed to the write line of the page memories and to set bit 6 of the inputs high.

To turn the next line blanking feature off, jumper on the board the two pads marked NLB. This grounds pin 11 of 29, and doesn't allow a write pulse to go to the memory.

Power Supply

The power supply schematic can be found in Fig. 14.

The power supply has provisions for +5, -5, and -12 volts at 2, .15, and .5 Amperes, respectively. The +5 supply consists of a 12.6 V, 2 A, C.T. transformer whose output is rectified and filtered and sent to two 7805 (LM340T-5) regulators. The two regulator chips are mounted to the cabinet and are hooked up in parallel.

The -12 supply is obtained by rectifying and filtering a 28 V, .85 A, C.T. transformer and feeding it into a 7912 (LM320T-12) regulator chip. The output of this chip is -12, and that output is sent to the -5 regulator. This consists of a zener diode hooked to the base of an MJE370 transistor. The output is between -5 and -6 volts.

All outputs are filtered with .1 disc capacitors and 100 uF electrolytics to improve regulator response and to filter out noise.

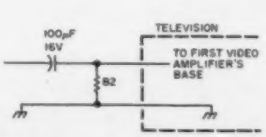


Fig. 10.

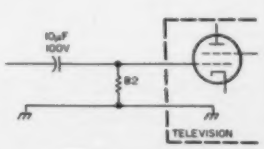


Fig. 11.

Troubleshooting

Power supply: When the board is finished, the power supply is not connected to the logic circuits. This prevents high voltage from ever reaching the integrated circuits, unless the power supply fails after it is initially tested.

To test the power supplies, the transformer is plugged into the board (through the molex connector) and the voltages are measured at the terminals marked +5, -5, and -12. If all of the voltages are correct (according to the table below), the three sets of pads can be jumpered, and the voltages measured again. If the voltages are still OK, the logic test procedure can begin. If not, you should start checking for solder shorts on the power supply lines.

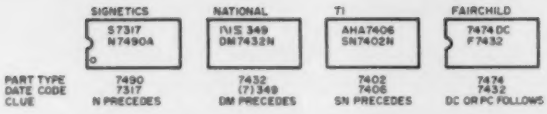


Fig. 12.

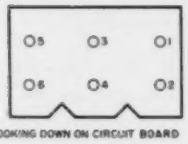


Fig. 13.

	Max.	Min.
+5	4.75	5.25
-5	-4.80	-5.90
-12	-11.7	-12.3

Logic testing: The 3320 display has a self-test feature which makes troubleshooting much easier. With this you can see any pulses that happen in the "visible" area of the frame. The visible area means any area of the frame that can be displayed on a television. Therefore, you can't see the sync pulses, and you must have these pulses to be able to display anything at all.

To use self-test, disconnect the jumper between the output shift register and pin 1 of 56 (between points D and E). This will take any video data that you may have off the screen. Next, connect pin 1 of the input connector to the signal line that you want to check. There should be a series of horizontal (for slower clocks) or vertical (for faster clocks) lines on the screen, where white is a logical one and black is a zero. To be sure that sync is there, and to be sure that the display is hooked to your television correctly, follow the above procedure and hook your jumper to a moderately fast clock (such as the G clock). In this case you should see 10 or 11 pairs of black and white vertical bars on the screen. If nothing is there, first check the connection to your television; if you're sure that's OK, you will need a scope to check the sync pulses and the output of the buffer transistor. After you get self-test working, go through any circuit that you think is bad and look at all of the signals. Please note that only TTL level signals can be displayed using self-test, so don't look at the output of the page memory's clock driver, or either of the negative supplies!

If the unit does not work, the first thing to check is the timing chain. The T clock should be 60 Hz (one horizontal line on the screen). If it is not there, start at the A clock and work your way through the chain. If the master clock is not oscillating, be sure that IC1 is a 7404 made by Texas Instruments. If it is not, it must be replaced with one that is. If the timing chain is all right, check the Ø1 and Ø2 clock pulses at pins 3 and 11 of 19, respectively. There should be 1024 small white dots on the television screen. If there are only 1000, check the divide by 24 circuit, ICs 21, 13, and 22. If there are dots all over the screen (many more than 1024), make sure that character area is high only for the area shown in Fig. 2, and that the divide by 24 circuit is working. L1 should be one horizontal scan line out of eight white, while load should be somewhat similar to the C, D, and E clocks, except the pulses will only appear during character area.

If everything seems to be OK in the timing section, check the cursor control. If a cursor appears on the screen, but won't move when pulsing the strobe line, first be sure that the jumper is in for positive or negative strobe! Then, see if there is a pulse at pin 5 of 36 that lasts exactly one frame (it will appear as a flash on the screen). If this pulse is not there, try clearing the unit by bringing the clear line to +5 volts. Because of the random states that logic

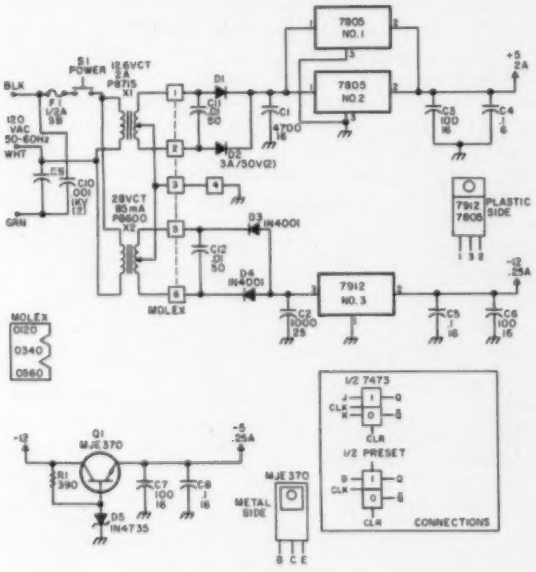


Fig. 14. Power supply.

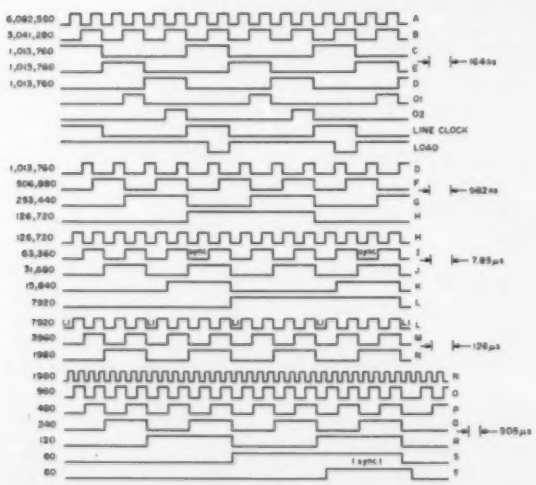


Fig. 15. Timing chain.

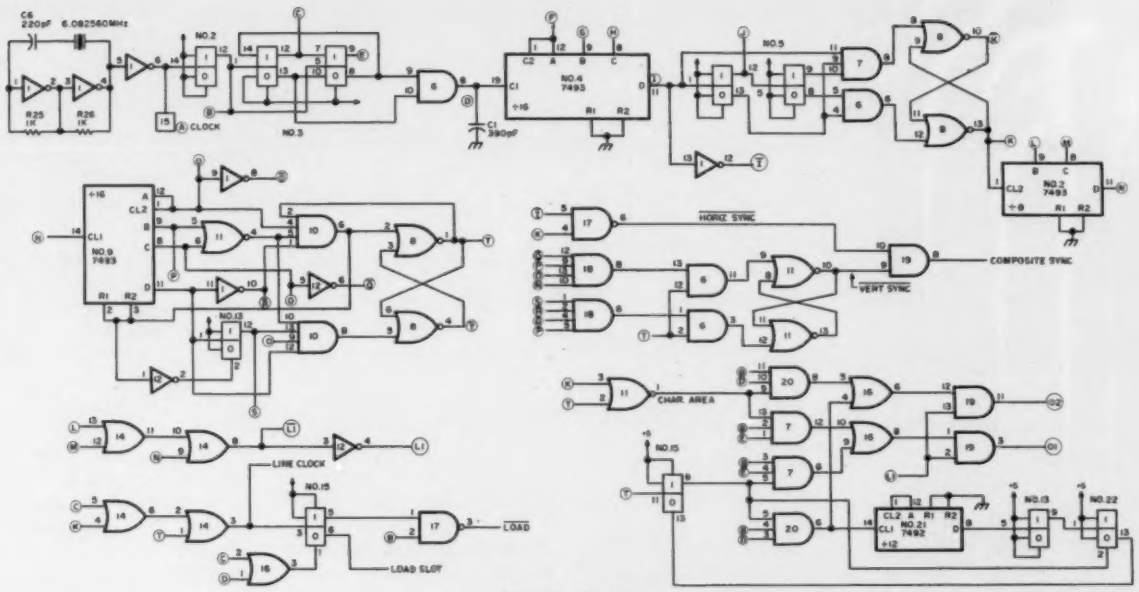


Fig. 16. Timing.

comes up in, some units must be cleared before data can be entered.

If a cursor doesn't appear, look for a character clock (1000 pulses on the screen) at pin 11 of 25. Be sure that this is clocking the flip flops and the divide by 10 (ICs 30 and 31). There should be 25 short normally high pulses per frame at pin 11 of 32. These 25 pulses are sent through an AND gate to clock the two divide by five circuits. If nothing is clocking, check the clear lines to the flip flops and the dividers. The output of the second divider (IC34) should cause flip flop IC32 to toggle once per frame. This flip flop will soon be reset by the next character clock pulse. This line is called character position, and is used to put the cursor on the screen and to bring the write line of the memory high during an update cycle.

If the timing and cursor sections both work, but the memory either won't enter data, won't fill with spaces when the clear line is brought high, or is creating random characters on the screen, the

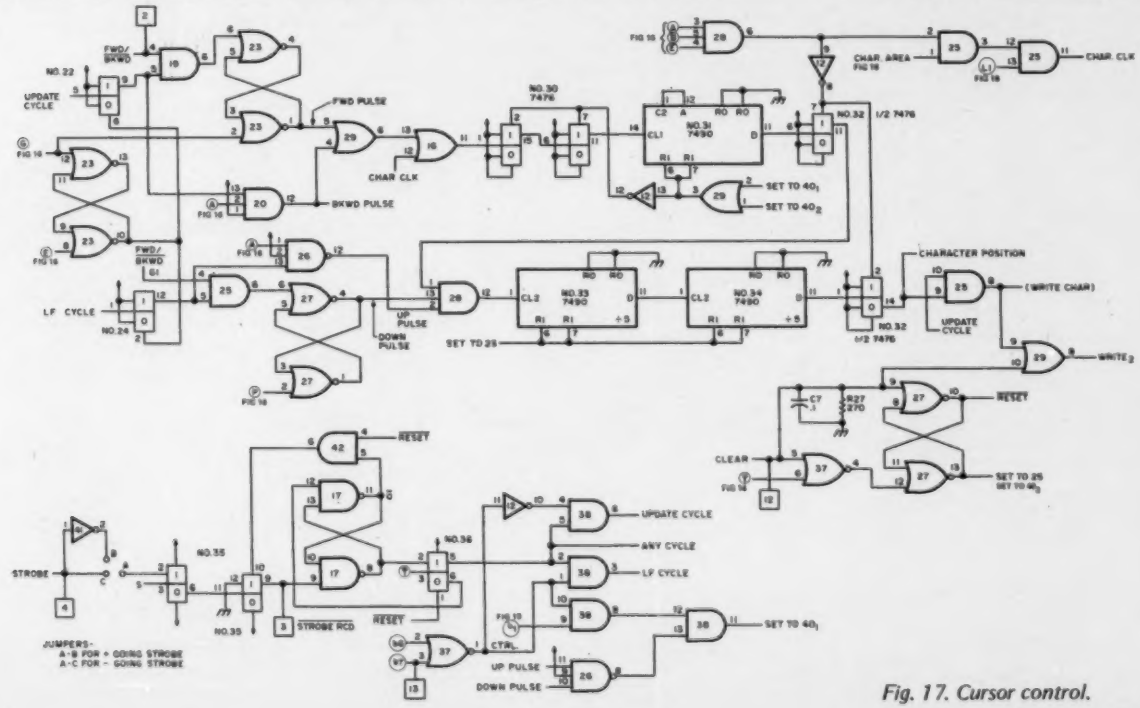


Fig. 17. Cursor control.

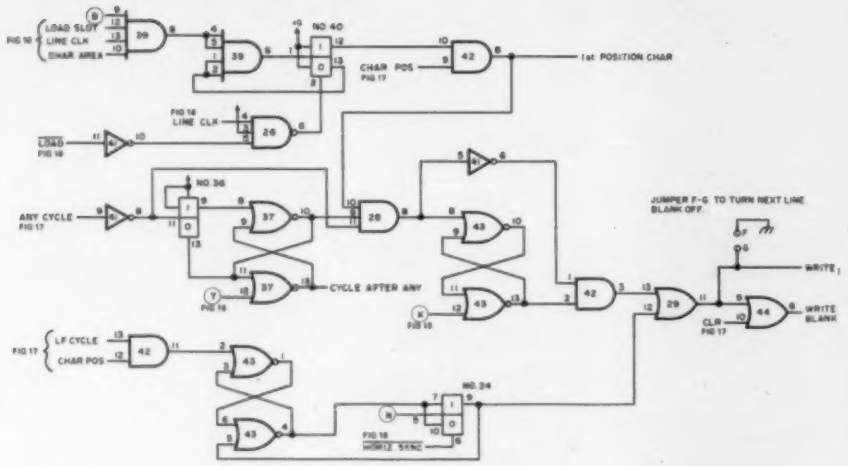


Fig. 18. Next line blanking.

memory section of the unit must be checked. First, if the screen has a series of vertical white lines on it, check pin 11 of 53 for a low. If it is not low (it should go high for a brief period to display the cursor), the character generator chip is not enabled and all ones will appear at its output. If this is not the problem, check all of the TTL level clocks such as L1, Ø1, Ø2, A clock, and the line clock. If these seem all right, check to be sure that the write line (pin 5 of circuits 46-51) goes high for a very short period during an update cycle. If it does not, check back through the circuit for the two write lines to see where they stop working. If everything is OK so far, you will need an oscilloscope to check the outputs of the clock drivers, circuit 45. There should be very little overshoot on these two clocks, and they must swing from about +5 to -12. *Do not look at these high level clocks with self-test. If this was done, circuit 56 must be replaced.* If the screen has a lot of characters that are shifting randomly, be sure that there are 1024 clock pulses at pins 11 and 3 of 19. If there are 1024 pulses per frame (on the screen), you must check the high level clock pulses from the clock driver *with an oscilloscope.*

If everything works except the next line blanking, be sure that you did not jumper the NLB pads on the circuit board, which will cause the next line blanking feature to be turned off. If the feature works with a line feed but not for a character in the first position, move the cursor to the first position of any line and check for a short pulse at pin 8 of 42. There will only be one pulse per frame. If it is not there, be sure that pin 2 of 40 is not always grounded, causing the flip flop to stay cleared, and that the same flip flop is being clocked at pin one. If that pulse is OK, see if it is getting through if it is during an update or line feed cycle (any cycle) or is the cycle after such. Pin 9 of 28 goes low for the cycle after any cycle. The pulse at pin 8 of 28 sets a set/reset flip flop, circuit 43, at pin 8, which brings the write line high. The line goes low when the K clock comes again. If the unit does not blank the next line after an LF cycle, see if the flip flop, circuit 43, is being set at pin 2, making pin 4 go high. If it is not, be sure that pin 5 is not always high, holding it reset. If pin 9 of 24 is always low, be sure that pin 10 of that circuit is not pegged low, keeping the flip flop cleared. The output of this flip flop also goes to set the write line high for one line.

If you find that a circuit is "bad," first check the following things:

1. That the power supply and ground are at acceptable levels on the chip.
2. That all of the input signals are within TTL specifications (low is less than .8 V; high is greater than 2.4 V).
3. That there are no unsoldered pins to the circuit, and no etch or solder shorts between a wire running to the chip and something else.

A large number of problems can be solved by checking these things before replacing an integrated circuit.

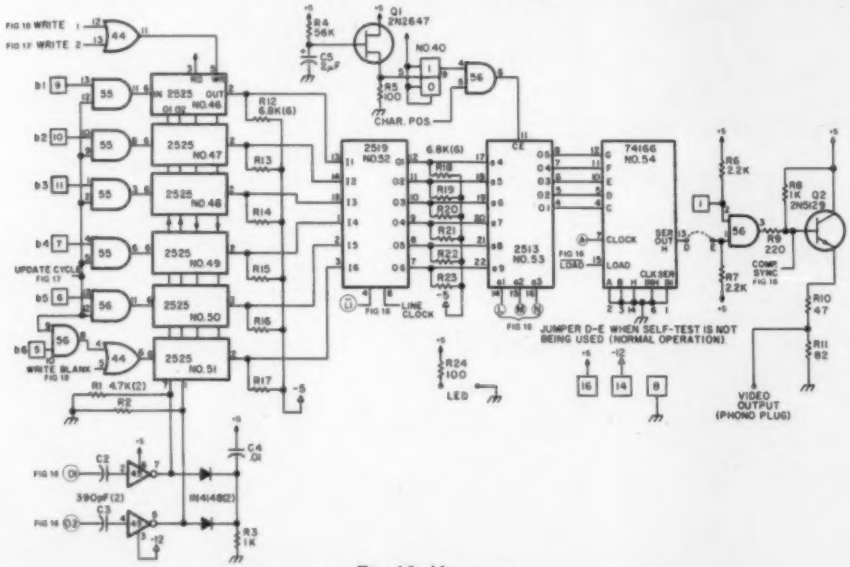


Fig. 19. Memory.

Operation

All connections to the keyboard and video monitor are through a DIP plug and a

DIGITAL DATA RECORDER for

Computer or Teletype Use Up to 4800 Baud

Uses the industry standard tape saturation method to beat all FSK systems ten to one. No modems or FSK decoders required. Loads 8K of memory in 17 seconds. This recorder enables you to back up your computer by loading and dumping programs and data fast as you go, thus enabling you to get by with less memory. Great for small business bookkeeping. Imagine! A year's books on one cassette.

Can be software controlled. Comes complete with a software program used to test the units in production (8080). Manual includes software control hook up data and programs for 8080 and 6800.

SPECIFICATIONS: Model CC7 $149.95

A. **Recording Mode: Tape Saturation binary. This is not an FSK or Home type recorder. No voice capability. No Modem. Runs at 2400 baud or less Asynchronous and 4800 baud Synchronous. (Simple external Synchronizer diagram furnished.) Runs at 3.1"/sec. Speed mechanically regulated ± .5%.**

B. **Two channels (1) Clock, (2) Data. Or two data channels providing four (4) tracks on the cassette. Can also be used for NRZ, Bi-Phase, etc.**

C. **Inputs: Two (2). Will accept TTY, TTL or RS 232 digital.**

D. **Outputs: Two (2). Board changeable from TTY, RS232 or TTL digital.**

E. **Erase: Erases while recording one track at a time. Record new data on one track and preserve three or record on two and preserve two.**

F. **Compatibility: Will interface any computer using a UART or ACIA board. (Altair, Sphere, $M6800_t$ etc.)**

G. **Other Data: 110-220 V – (50-60) Hz; 2 Watts total; UL listed; three wire line cord; on/off switch; audio, meter and light operation monitors. Remote control of motor optional. Four foot, seven conductor remoting cable provided.**

H. **Warrantee: 90 days. All units tested at 110 and 4800 baud before shipment. Test cassette with 8080 software program included.**

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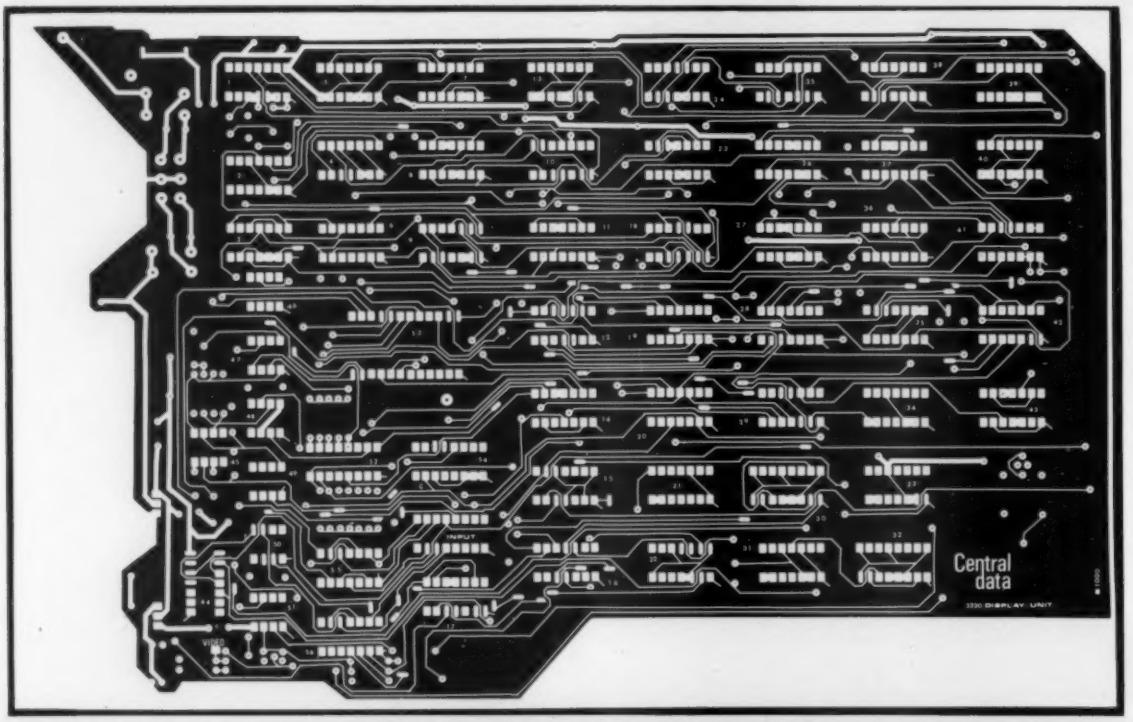
phono plug, respectively. The phono plug goes directly to the input of your monitor. It is the 2.25 V composite video signal whose waveform was given in Fig. 3.

The other connector consists of a 16 pin DIP socket soldered to the board, along with a cable that has a plug which will fit the socket. The cable's wires correspond to the pins on the plug as is shown in Fig. 9.

The signals that are available at the socket are listed in Fig. 19, the memory schematic. The strobe received signal is an output that acknowledges receipt of



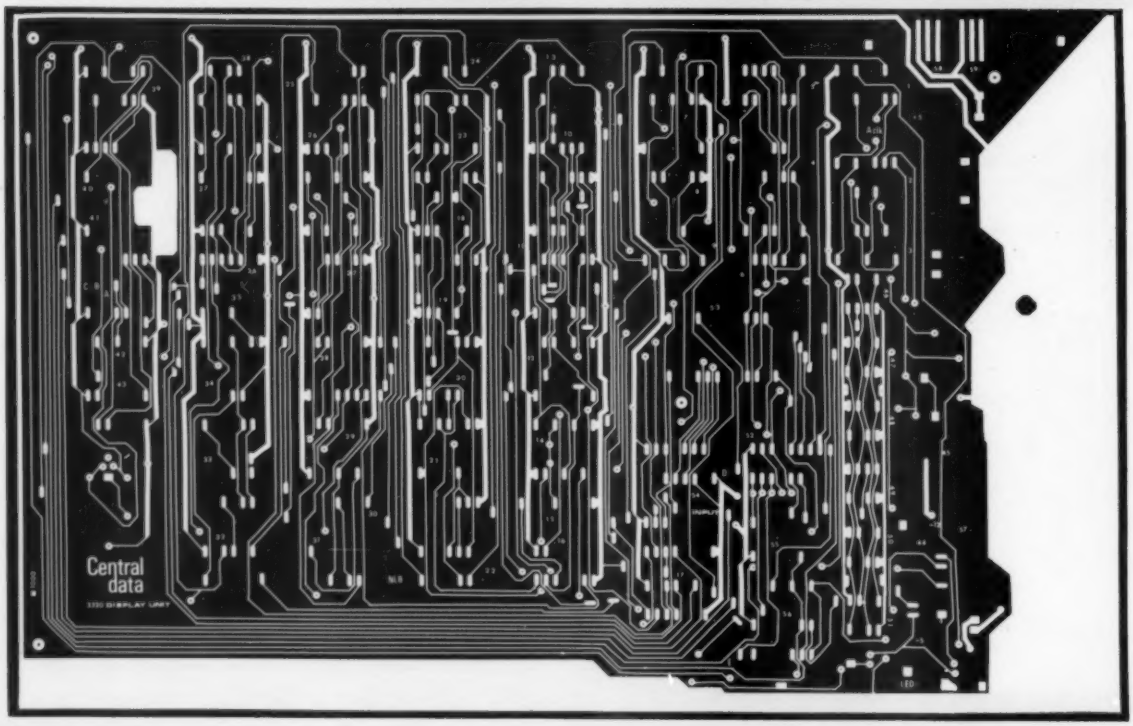
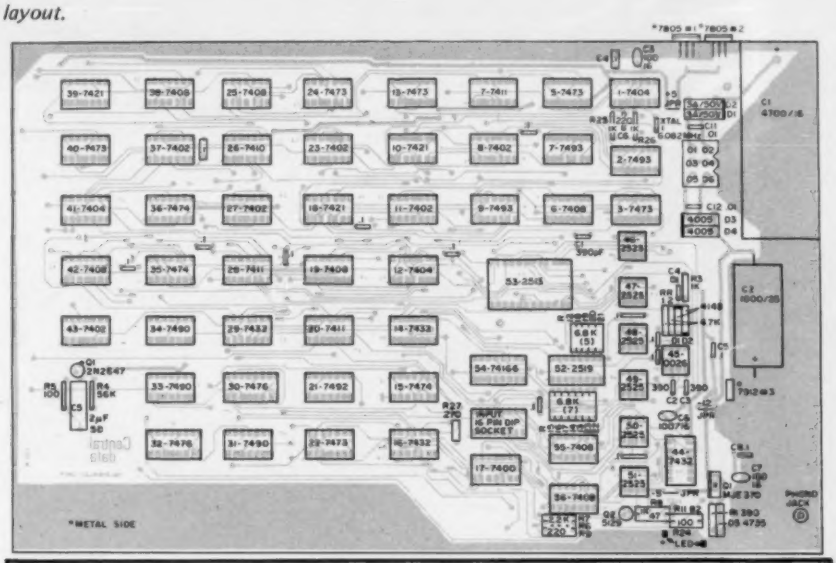


Fig. 20. PC board and component layout.



the strobe signal. It is a very short pulse that is used by the input options as well as some types of keyboards. Bringing CLEAR high will empty the screen and move the cursor to the upper left hand position. Sometimes, because the logic comes up in random states, the unit will have to be cleared before it will operate.

FWD/BKWD is an input that decides in which direction the cursor will move. If it is high, the cursor will move forward or down, while if it is low the cursor will move backward or up.

If you have an input option there is another DIP socket on the small option board which matches the one on the main board. The cable in this case had a DIP plug on both ends.

Modification of Your Television

WARNING: Do not attempt to use as a video monitor any television that has one side of the ac line connected to the chassis or to ground. To connect such a television will probably cause major damage to your display unit. The modification procedure is simply a matter of capacitively coupling the video output from your display unit to the first video amplifier stage of your television.

If you have a transistor television, use the circuit of Fig. 10 as a guide for the modification. If you have a tube type set, the circuit of Fig. 11 can be used.

With the tube type television, a higher voltage may be required to provide adequate contrast. A video amplifier can be inserted between the video output and the capacitor to solve this problem. With either set, there is a small possibility that it requires positive sync polarity. Since the data is transmitted with negative sync, a video inverter must be

Parts List

TTL Integrated Circuits
- 1 7400
- 6 7402
- 3 7404
- 7 7408
- 1 7410
- 3 7411
- 3 7421
- 4 7432
- 6 7473
- 3 7474
- 2 7476
- 3 7490
- 1 7492
- 3 7493
- 1 74166

MOS Integrated Circuits
- 1 MH0026CN
- 1 2513
- 1 2519
- 6 2525

Semiconductors
- 1 2N2646
- 1 2N5129
- 2 1N4148

Resistors (all ¼ Watt)
- 1 47
- 1 82
- 1 100
- 1 220
- 1 270
- 4 1k
- 2 2.2k
- 2 4.7k
- 12 6.8k
- 1 100k

Capacitors
- 1 220 pF disc
- 3 390 pF disc
- 1 .01 uF disc
- 13 .1 uF disc
- 1 2 uF/16 V, electrolytic
- 2 100 uF/16 V electrolytic

Miscellaneous Parts
- 5 Plastic standoffs
- 1 6.082560 MHz crystal
- 1 16 pin DIP socket
- 1 16 pin DIP plug with cable
- 1 phono jack
- 1 phono plug
- 1 Central Data B1000 circuit board

The following apply only if an on-board power supply is being built.

Semiconductors
- 2 7805 or LM340T-5
- 1 7912 or LM320T-12
- 1 MJE370
- 1 1N4735
- 2 1N4001
- 2 3 Ampere diodes

Capacitors
- 1 1000 uF/25 V electrolytic
- 1 4700 uF/16 V electrolytic
- 2 .01 disc
- 2 .001 disc (1kV)
- 2 .1 disc
- 1 100 uF/16 V electrolytic

Other Parts
- 1 390 Ohm, ¼ W resistor
- 1 1 Ampere fuse
- 1 fuse holder
- 1 line cord
- 1 strain relief for line cord
- 1 SPST toggle switch
- 1 Molex 03-09-1064
- 1 Molex 03-09-2062
- 6 Molex 02-09-1133
- 6 Molex 02-09-2143
- 1 Stancor P-8715 transformer
- 1 Stancor P-8600 transformer

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inserted between the display unit and the television.

Assembly: General Information

The circuit boards used in the 3320 display system are all double-sided with plated-through holes. Because of this you only have to solder the components on the bottom of the board. The plated-through holes make the connection to the top of the board. The components should be soldered with a low wattage (40-60 W), moderate temperature (approximately 750°) soldering iron. The iron should also be grounded when soldering the MOS integrated circuits. This is not absolutely necessary, however.

Be sure to mount all integrated circuits according to their pin one mark, not their lettering. Occasionally a circuit is lettered upside down. Most ICs are printed with both a part number and a date code. The date code consists of the year and the week that the circuit was produced. Example: January 30, 1977=7705.

The placement of the part number and date code for most circuits is shown in Fig. 12.

Also, be very careful to prevent solder shorts. This type of problem is very difficult to find later, so if it is done with care now it will save you a lot of time when troubleshooting.

Note that all pin one markers on the integrated circuits are towards the lower left hand corner of the board, except for circuit 44, which is toward the lower right hand corner. IC1 must be a Texas Instruments circuit; otherwise you are not assured that your master clock will oscillate. A square pad on the top of the board indicates the cathode (banded) end of diodes and the positive end of electrolytic capacitors.

Be sure to jumper the two terminals marked "A clk" near circuit 1. If you ever want to run your display off an external clock, break the jumper and connect the external clock to the lower pad. Also jumper the correct pads between circuits 41 and 42 corresponding to the polarity of your strobe pulse. If you are running off an external power supply, wire your power supply to the circuit side of the three sets of pads marked +5, -5, and -12. Also jumper pads D and E to connect the shift register to the buffer transistor.

A phono jack is installed in the ¼ inch hole, and a jumper is made between its center and the pad on the bottom of the board marked VIDEO. Connection to your monitor can be made using a phono plug and some RG-174U cable.

If you are going to use the on-board power supply, follow the parts placement diagram shown in Fig. 20. Be sure to mount the 7912 and the MJE370 transistor on heat sinks. The two 7805 regulators must be mounted at right angles to the board, and must be attached to a heat sink at least 4" x 9" x 1/16", if aluminum. To mount the regulators to the board, bend the leads (where they taper off) at a 90° angle. Then put some solder on each of the leads, along with the pads on the circuit board where they will be mounted. Then set one regulator on the circuit board and, one by one, heat the leads so that the solder melts and attaches the lead to the board.

Solder the transformer leads to the off-board molex connector using the configuration shown in Fig. 13. Two .001 disc capacitors should be placed across the power line to prevent high frequency noise from leaving the unit through the line. ■

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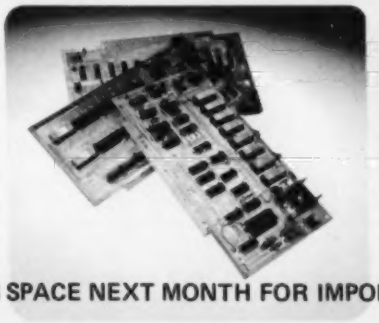

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Your Computer Can Talk Morse

-- even a computer can learn the code!

So you have that new-fangled "computer" in your shack. You are through with the headaches of wiring it and you have gotten past the frustration of programming it to type out your name. You are even to the point that you understand some of the games that came with it so well that you can cheat the machine. What's that? You want to try something else? How about calculating Oscar orbits? No. Well . . . how about true bearings and distances to DX contacts from longitude and latitude information? No? You want it to do something, not just arithmetic.

I've got it! You've been wanting one of those keyboard to Morse code units. Why not program the computer to convert ASCII to Morse? Then you could send prepared text, CQs, or just copy from the keyboard that you have. Say again, OM? How? Oh, sure, I remember a few ways to convert data. OK. Here goes . . .

First, you need a method of generating the Morse characters. You need some way for the computer to turn a relay or TTL circuit on and off. From there, you can drive the keyed circuit in your rig. Sorry, I can't help you with the hardware. Maybe one of the other fellas can help.

Next, you need some way to time the on and off periods. A timing loop. You never heard of a timing loop? Every instruction in the machine takes a certain amount of time, right? Let's assume that we have a routine (a short program segment) that will place a number in a register, then subtract one from the register, then check to see if the number left in the register is zero. If the result is not zero, the routine returns to the subtract instruction. If it is zero, then it executes the next step of the program.

What has the routine done? Nothing, really, but that is the point. The computer has been twiddling its thumbs for as long as it takes to count down that register. Now, if it takes 30 microseconds to subtract one from the register, test the register for zero, and branch back to the subtract instruction; then by changing the number that you start with, you can adjust the timing. (If you start with

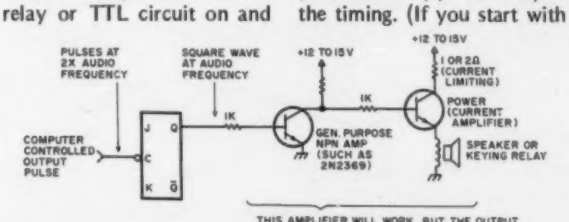

Fig. 1.

Item No.	Character Table	Value Table
1	A	13
2	B	87
3	C	119
4	D	23
5	E	1
6	F	117
7	G	31
8	H	85
9	I	5
10	J	253
11	K	55
12	L	93
13	M	15
14	N	7
15	O	63
16	P	125
17	Q	223
18	R	29
19	S	21
20	T	3
21	U	53
22	V	213
23	W	61
24	X	215
25	Y	247
26	Z	95
27	double dash --	855
28	understood	469
29	attention	884
30	0	1023
31	1	1021
32	2	1013
33	3	981
34	4	853
35	5	341
36	6	343
37	7	351
38	8	383
39	9	511
40	comma ,	3935
41	period .	3549
42	question mark ?	1525
43	semicolon ;	1911
44	colon :	1407
45	parenthesis ( )	3575
46	quotes "	1885
47	dash -	3415
48	fraction bar /	471
49	apostrophe '	2045
50	wait	173
51	end of message	477
52	end of work	3541
53	blank	0
54	error	21845

Table 1.

6000 that will give 6000 x 30 usecs = 180,000 usecs or 180 msecs.)

Now, suppose that we take a number, like 117, and divide it by 4 (generating the quotient and the remainder). Q = 29; R = 1. If the remainder is a 1, send a dit; if it is a 3, send a dah. Now take the quotient and divide it by 4. Q = 7; R = 1. Again we send a dit. Divide the quotient again by 4. Q = 1; R = 3. This time we send a dah. Again, divide by 4. Q = 0; R = 1. Another dit. Divide again by 4. Q = 0; R = 0. This time the result is zero, which is the signal to stop sending the character. Dit dit dah dit came out F the last time I heard it.

Table 1 contains two lists. The first is a list of characters. The second is a list of the numbers that correspond to the characters in the first list. Notice that some of the characters do not have ASCII symbols. You will have to assign them some arbitrary symbol from your keyboard if you want to use them.

Now, to convert the ASCII code to the number set that I have shown you. There are two ways to program the computer to look down the table of numbers. The first is to treat the ASCII character you are trying to convert as a binary number that can be modified by arithmetic into another number that will specify to the program the position in the number table of the proper number for the original ASCII character. It is not really as complicated as it sounds.

The second method is to have a second table in the computer that contains ASCII characters in the order shown in Table 1. The program then steps down the character table looking for the proper ASCII character. When it is found, the program then looks the same number of steps down the number table, and there it is!

The only thing left to do is get the next ASCII character, and start the table lookup all over again.

Table 2 shows the FORTRAN program that I used to verify the method. I took out the machine dependent portions to make the method easier to understand. For those of you not familiar with FORTRAN, the program statements that begin with C are comments and are used to explain or clarify the preceding instructions. The CALL statement tells the program to turn control over to a subroutine (a program segment that performs a task and then returns to the point after where it was called). The variable names that are in parentheses following the subroutine name are called arguments and are used to pass information from the main program and the subroutine.

The GO TO 50 statement tells the computer to take its next instruction from the statement that is labeled 50, which I did not include in this portion of the program. The string of asterisks (usually called stars because

Table 2.

```
      *
      *
      *
C
C     AT THIS POINT THE ASCII CHARACTER TO BE CONVERTED IS IN I
C
      CALL TBL (I,K)
C
C     TBL IS THE TABLE LOOK UP SUBROUTINE
C     K CONTAINS THE MORSE WORKING NUMBER UPON RETURN
C
      CALL MORSE(K,M1,M2,)
C
C     MORSE IS THE SUBROUTINE THAT GENERATES THE MORSE CHARACTER
C     M1 IS THE LENGTH OF A DIT IN MILLISECONDS (1200 MS/SPEED IN WPM)
C     FOR THE SPEED THAT THE CHARACTER IS TO BE SENT.
C     M2 IS THE LENGTH OF THE PAUSE BETWEEN CHARACTERS (1200 MS/WPM) FOR
C     USE IN MAKING PRACTICE TAPES WITH EXAGGERATED PAUSES.
C
      GO TO 50
C
C     OBTAIN THE NEXT ASCII CHARACTER
C
      *
      *
      *
      SUBROUTINE TBL(I,K)
      DIMENSION ICHAR(54),NUMBER(54)
C
C     THIS SUBROUTINE SCANS THE TABLE OF ASCII CHARACTERS IN ICHAR FOR
C     A MATCH TO THE CHARACTER IN I. ON A MATCH IT RETURNS THE
C     CORRESPONDING MORSE WORKING NUMBER FROM NUMBER IN K. NON-MATCHES
C     ARE CONSIDERED ERROR CHARACTERS. (THE 54TH CHARACTER)
C
      DATA ICHAR/ 1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM
     1   1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ,1H=,1H^,
     2   1H@,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H.,1H-,1H?,1H;,
     3   1H:,1H(,1H",1H-,1H/,1H',1H%,1H+,1H*,1H ,1H#                /,
     4 NUMBER/13,87,119,23,1,117,31,85,5,253,55,93,15,7,63,125,223,29,
     5   21,3,53,213,61,215,247,95,855,469,884,1023,1021,1013,981,853,
     6   341,343,351,383,511,3935,3549,1525,1911,1407,3575,1885,3415,
     7   471,2045,173,477,3541,0,21845                 /
C
      DO 5 J=1,53
      IF(ICHAR(J).EQ.I) GO TO 7
5     CONTINUE
      J=54
7     K=NUMBER(J)
      RETURN
      END

      SUBROUTINE MORSE(K,M1,M2)
C     THIS ROUTINE CONVERTS K INTO MORSE ON AND OFF PULSES
C
      I=K
      IF(I.EQ.0) GO TO 20
C
```

nobody can say that other word) indicates that there is more to the program that is not included.

The SUBROUTINE statement identifies the coding to the next END statement as a subroutine with the name specified, and is completely independent of all other coding. The DIMENSION statement indicates that ICHAR and NUMBER are arrays or tables with 54 elements. The DO loop, indicated by DO 5 J=1,53, states that J is to be set to the value 1, (then) all statements up to and including the one labeled 5 are to be executed, (then) the value of J is to be increased by one and the statements are executed again and again. After the statements have been executed with the value 53 in J, then the next statement after 5 is performed. The IF statement means that if the Jth element of ICHAR is equal to I, then jump out of the loop and take the next instruction from 7. The statement between 5 and 7 insures that an ERROR character (element 54 of the tables) is used if no match causes the jump out of the loop to statement 7. Statement number 7 puts the proper value into K and the routine is finished. This is indicated to the computer by the RETURN statement. Again the END statement is used to show the limit of the subroutine.

```
C       CHECK FOR A BLANK
C
10      J=MOD(I,4)
C
C       FIND THE REMAINDER OF I/4
C
        I=I/4
C
C       FIND THE QUOTIENT
C
        IF(J,EQ.0) GO TO 15
C
C       CHECK FOR END OF CHARACTER
C
        CALL ON
C       TURN ON THE CIRCUIT
        CALL WAIT(M1*J)
C       WAIT FOR M1 X J MILLISECONDS  J=1 DIT   J=3  DAH
        CALL OFF
        CALL WAIT (M1)
C       TURN IT OFF FOR M1 MILLISECONDS
        GO TO 10
C       CHECK FOR NEXT DIT OR DAH
C
15      CALL WAIT(M2*2)
        RETURN
C       END THE CHARACTER AND RETURN FOR NEXT
C
20      CALL WAIT(M2*4)
        RETURN
C       SEND AN INTER-WORD SPACE
C
        END
        SUBROUTINE WAIT(N)
C
C       THIS SUBROUTINE WAITS N MILLISECONDS BEFORE RETURNING.
C
        DO 5 I=1,N
C
C       AT THIS POINT INSERT ANY ROUTINE THAT REQUIRES 1 MILLISECOND TO
C       PERFORM. IF K IS CHOOSEN PROPERLY, USE THIS –
C                       DO 6 J=1,K
C               6       M=K
C
5       CONTINUE
        RETURN
        END
        SUBROUTINE ON
C
C       THIS SUBROUTINE TURNS ON THE KEYED CIRCUIT. IT MAY HAVE TO BE
C       WRITTEN IN MACHINE LANGUAGE.
        RETURN
        END
        SUBROUTINE OFF
C
C       THIS SUBROUTINE TURNS THE KEYED CIRCUIT OFF. IT MAY HAVE TO BE
C       WRITTEN IN MACHINE LANGUAGE.
C
        RETURN
        END
```

In the subroutine MORSE the argument K is transferred into the dummy or working variable I, and is then checked to see if it is zero (indicating a blank). The next statement uses the FORTRAN-supplied function MOD that performs modular arithmetic of the first argument by the second. (It finds the remainder of I divided by 4.) I=I/4 places the quotient of I divided by 4 back into I. That sets I up for the next pass through the loop. The remainder is then check for zero, which indicates the end of the character. The keyed circuit is then turned on by the subroutine ON. The call for the subroutine WAIT demonstrates that FORTRAN allows the programmer to specify an arithmetic operation inside the argument list. In this case J is to be multiplied by M1 and the result is then used as the argument to the subroutine. The value of J (either 1 or 3) times the number of milliseconds to wait for a dit will generate the proper spacing needed. OFF is used to (what else) turn off the keyed circuit.

The coding that I show for WAIT, ON, and OFF is intended only to illustrate the actions that they perform, not how to program them. There are far too many differences in the many computers around to attempt specifying any particular routine.

As you may have guessed, this program was checked out on a large computer system. And you probably do not have a FORTRAN COMPILER on your new system. That means that you will

have to write the program for your machine, but the method will work.

Come to think of it, you don't have to have your own computer, if you have access to one. A short length of wire near the right indicator lamp or other circuit, combined with the right timing loop, will pick up an rf signal that can be used to drive a circuit. This does require two timing loops, one with rf and one without. One school in the Army uses a transistor radio set next to an IBM 1401 computer to generate its code practice tapes.

Well, I hope you have fun programming your computer. What's that? What else can you do after that? Well, I was thinking about that. Of course on-off RTTY needs only a different table. FSK RTTY? Now if you had a two tone audio frequency oscillator, you could drive that into the mike input to your SSB rig; of course, that's 100% duty cycle and you might have to modify the power level some. I was thinking that, with about eight levels of gray (I mean eight stepped tones) and that SSB audio input scheme, why, we could generate some of the fanciest computer generated SSTV signals you ever saw.

Hmmmmmm? Receive Morse with a computer. You know, I wrote some routines for that last week. It's easier to do RTTY because the timing is all the same. Morse from an electronic keyer is not too bad, but I'm sure I found the way to copy even the poorest fist. Tonight? Aww, come on! It's 2:00 am now and I gotta catch the bus for work by seven . . . What? Sure computers can draw things on the line printer — some can give better resolution than a TV set. Record SSTV and print it out? Why not just print out QSL cards complete with addresses. Fully automated QSO? Yeah, but suppose the other guy is a computer, too? . . . ■

If you are on 2-meters now

. . . but you're tired of being stuck with too few channels

. . . and you'd like more versatility

. . . and you really do need tunable VFO

. . . and SSB-CW (don't forget OSCAR!)

. . . you need Kenwood's NEW

TS-700A

It solves all of these problems and lots more. And best of all . . . the TS-700A reflects the type of quality that has placed the Kenwood name out front.

- Operates all modes: SSB (upper & lower), FM, AM and CW
- Completely solid state circuitry provides stable, long lasting, trouble-free operation
- AC and DC capability. Can operate from your car, boat, or as a base station through its built-in power supply
- 4 MHz band coverage (144 to 148 MHz) instead of the usual 2
- Automatically switches transmit frequency 600 kHz for repeater operation . . . reverses, too
- Outstanding frequency stability provided through the use of FET-VFO
- Zero center discriminator meter
- Transmit/Receive capability on 44 channels with 11 crystals
- Complete with microphone and built-in speaker
- The TS-700A has been thoroughly field-tested. Thousands of units are in operation throughout Japan and Europe

The TS-700A is available at select Kenwood dealers throughout the U.S. For the name of your nearest dealer, please write.

KLAUS RADIO Inc.

8400 N. Pioneer Parkway, Peoria IL 61614, Phone 309-691-4840
Cliff Morris W9GAO — Jim Plack W89BGS

COMPARE

Feature	SWTPC 6800	Theirs—Your Choice
Processor—	The best "Motorola MC6800". Two accumulators, automatic vectoring, seven addressing modes and complete set of branch instruction. The more powerful instruction set and memory orientated architecture makes programming very straight forward and easy to learn. Operates from a single +5 Volt supply.	Some are almost as good in one respect or another. None can offer all of the features of a real MC6800.
Memory—	Static 2102-1 type memories. Fast enough to allow the processor to run at full speed at all times. No refresh cycles, no problems with glitches and flakey dynamic memories.	Various types available. Often not included in the basic kit, and must be purchased as an extra cost option. (this is an option?)
Power Supply—	10 Amp. Capacity. More than enough to power a fully expanded system. Power supply uses a rugged 25 amp bridge rectifier and a 91,000 mfd computer grade filter. Regulators on the individual plug-in cards.	Some expand more than others with the supply provided. Check carefully.
Expansion—	Seven slots for processor and memory boards. Eight I/O slots. I/O's are programmable type. All decoding and clocking provided from mother board making additional interfaces very inexpensive. Baud rates may be independently selected for each interface card.	Varies from "0" to 16, or more.
Start Up—	Automatic start and reset provided by "Motorola" Mikbug® ROM. No fiddling with switches and status lights. Just push the button and go. Use of standard Motorola firmware makes software 100% compatible with Motorola evaluation module programs.	Anything from switch and status light to automatic ROM loading. If ROM is not a standard part, the software may be unique to that machine.
Clock—	Crystal controlled master clock oscillator with high power clock drivers. Insures reliable, consistant operation with no noise problems. Baud rate divider operating from the master clock oscillator provides the various baud rates for the I/O devices with crystal accuracy. No adjustments necessary to lock everything in at the proper frequency.	Anything from cheap dual monostable systems to crystal control. Crystal oscillators are best. Dual one-shots can develop phase overlap problems and are more susceptible to noise problems.
Buffering—	Tri-state bi-directional buffers on all data lines, address lines and clock lines on ALL boards. Insures trouble free noise immune operation.	Various—from full buffering to almost no buffering. Lack of full buffering can lead to noise problems.
Documentation—	Very complete. Our own notebook, plus the "Motorola" Programming Manual and Applications Manual. Detailed instructions along with sample programs help you to understand programming. You will be ready and able to write your own programs after mastering these instructions.	
Price—	**$395.00** **For the whole thing.** You get the case, power supply, processor 2K word memory and serial interface. No extras to buy. Just connect a terminal and start operating.	As we said—COMPARE.

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COMING ATTRACTIONS

CASSETTE INTERFACE—Our new AC-30 will make it possible to load and dump programs to cassette tape using ordinary inexpensive recorders. Uses the standard "Kansas City" recording format for compatibility.

LINE PRINTER—At last—hard copy at a reasonable price. Our new PR-40 printer will print program listings, or any other material you might want to keep in printed form. A dot matrix printer at a price you are not going to believe.

GRAPHICS TERMINAL—A universal—works with any computer—graphics terminal. With this connected to your computer you can play games in style. May be used with our CT-1024 to put both graphics and alpha-numerics on the screen simultaneously.

PLEASE—Don't call or write. We will have details on these projects in our next ad. Government regulations prevent us from giving prices, or taking orders yet.

SOFTWARE—The flood is near. Editor and assembler now available. BASIC and more games right away. Yours for the cost of copying. WE DON'T SELL SOFTWARE—WE GIVE IT TO YOU. ENJOY IT, COPY IT, WE WON'T COMPLAIN. . .

SWTPC Southwest Technical Products Corp., Box 32040, San Antonio, Texas 78284

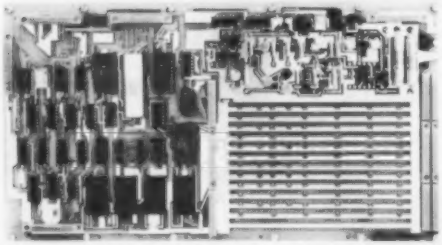
Thinking big made easy with the 8080+®

Just unpack the 8080+® microcomputer, connect it to a single 5 volt power supply, and you have an operating computer that's instantly ready to program.

$995

8080+® Microcomputer includes:

- **Control panel**—single step, load address, load register, 13 additional functions keys, 16 hexidecimal keys, 4 digit LEDS, address/data display, 4 status indicators and teletype interface.
- **8080 Single Board Computer**—single 5v supply internally stepped to −5, −9, +12 and tap for +5v all available in wire wrap area, fully buffered for buss driving, customized memory and I/O via 5" x 7" wire wrap section.
- **1K x 8 RAM**—low power version, burned-in, and margin-tested.
- **Control Panel Monitor (2-256 x 8 EPROMS)**—teletype and control panel interface.
- **I/O Cables (2)**



Industrial Quality • Fully Assembled • Fully Tested • Upward compatible to 64K x 8 memory (32K x 8 on single board) • Existing Operating System • Customized I/O • Riteable ROM

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Send me the 8080+ at $995, plus $18 for shipping and handling.
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GODBOUT

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

CATALOG PAGE 1

CAPACITORS

We added more capacity to our warehouse. Look at these:

TANTALUM CAPACITORS

2.2 uF @ 20V.....4/$1.00
2.7 uF @ 20V.....4/$1.00
3.3 uF @ 15V.....4/$1.00
4.7 uf @ 10V.....4/$1.00
22 uF @ 10V.....3/$1.00
33 uF @ 10V.....3/$1.00
39 uF @ 10V.....3/$1.00
47 uF @ 6V.....3/$1.00

ELECTROLYTIC CAPACITORS

10 uF, 250V, axial.....3/$1.00
12 uF, 250V, axial.....3/$1.00
100 uF, 10V, axial.....5/$1.00
100 uF, 35V, PC mount....4/$1.00
100 uF, 50V, PC mount....4/$1.00
220 uF, 25V, PC mount....4/$1.00
250 uF, 25V, axial .....4/$1.00
2000 uF, 30V, PC mount...1/$0.95
4000 uF, 20V, MalloryPFP 1/$0.95
10000 uF, 10V, axial.... 1/$1.25

MYLAR CAPACITORS

Cut and formed for PC insertion. High-Q and STABLE.

.0033 uF, 50V.....10/$1.00
.005 uF, 25V.....10/$1.00
.0068 uF, 50V.....10/$1.00
.01 uF, 50V.....10/$1.00
.02 uF, 50V.....10/$1.00
.033 uF, 50V.....10/$1.00
.047 uF, 50V.....10/$1.00
.068 uF, 50V.....10/$1.00
.1 uF, 50V.....10/$1.00
.22 uF, 50V.....10/$1.00
1.0 uF, 200V, 10%.....3/$1.00
5.0 uF, 100V, 10%.....2/$1.50
10 uF, 100V, 10%.....1/$1.50

DISC CERAMIC CAPACITORS

Small, low voltage types. Some may have leads cut and formed for PC insertion.

10 pF.....10/$0.45
220 pF.....10/$0.45
.001 uF.....10/$0.50
.005 uF.....10/$0.50
.01 uF.....10/$0.50
.02 uF.....10/$0.75
.05 uF.....10/$1.00
.1 uF.....10/$1.25

High-Voltage Electrolytics

150 uF @ 350V....75¢ ea, 2/$1.35
150 uF @ 350V + 200 uF @ 175V.... 95¢ ea, 2/$1.75
200 uF @ 175V....75¢ ea, 2/$1.35
10 uF @ 400V + 4 uF @ 350V + 100 uF @ 350V.....65¢ ea, 2/$1.20

AMERICAN MADE
85°C RATING
TWIST LOCK TYPE

RESISTORS!

100 OF ANY ONE VALUE $1.70
1000 OF ANY ONE VALUE $15.30

ALL RESISTORS 5%, EXCEPT (*) MAY BE 5% OR 10%.

polystyrene capacitors

For circuits requiring extremely accurate and stable capacitance, you can't do much better than a polystyrene cap. These are 5% or better accuracy, with leads cut and formed for PC insertion. 10 OF ANY ONE VALUE $1.00

Values available (all values in pF):

100 150 180 220 270 390 470
560 680 820 910 1000 1200
1500 1800 2000 2200 3300
3900

INDUCTORS

Ceramic, PC mount type: 10 OF ANY ONE VALUE $1.00. Choose from 1.0, 1.2, 2.0, 2.7, 2.8, 6.8, 8.2, 12, 18, 22, 24, 27, 30, 33, 43, 47, 68, 82, or 120 microhenries.

TRIMPOTS

Single-turn, ¼ watt, vertical PC mount. 5 of any one value $1.
Values available: 250Ω, 500Ω, 1K, 2.5K, 3K, 50K, 1M.

LEDs and READOUTS

DL704: .3" com. cath. $1.25 each 4/$3.95

DL707: .3" com. anode $1.25 each 4/$3.95

MAN74: .3" com. cath. $1.50 each 4/$5.25

MAN84: .3" com. cath, YELLOW. $1.95 each or 4/$7.50.

OR33: 3 digits in DIP .1" characters $1.75

MV1050: .1" discrete, bottom leads. 10/$1.00

.01% ACCURACY IN A TO-5 CAN...not just useful for fixed frequency oscillators, since most numbers can be used with simple binary dividers to generate other frequencies.

For example, 15.360 can divide down to 60 Hz for timing pulse purposes; 28.160 gives a perfect "A" 440 Hz signal; 16.384 divided by 2^{14} gives 1 Hz timing pulses; and so on. All frequencies $4.95 --- apply IC discount schedule for quantities. ALL FREQUENCIES IN KHz.

STATEK CRYSTALS

Choose from:

10.000	12.800	15.360
16.000	16.384	17.476
18.641	19.200	20.480
24.576	28.160	30.720
31.500	32.768	36.864
38.400	40.960	60.000
76.800	100.00	153.60
	240.00	

SOCKETS

CAVE Sterling™

Wire Wrap

3 level, gold plated

14 pin.....10/$3.70
16 pin.....10/$3.85
18 pin.....1/$0.75
24 pin.....1/$1.00
28 pin.....1/$1.25
36 pin.....1/$1.35
40 pin.....1/$1.75

SOLDERTAIL

Gold or tin plated

14 pin.....10/$3.70
16 pin.....10/$3.85
18 pin.....75¢ each
24 pin.....$1.00 each
28 pin.....$1.25 each
36 pin.....$1.35 each
40 pin.....$1.75 each

1.0*	4.7*	15*	47*	150*	470*	1.5K*	4.7K*	15K*	47K*	150K*	470K*	1.5M*	4.7M*
1.2*	5.1	16	51	160	510	1.6K	5.1K	16K	51K	160K	510K	1.6M	5.1M
1.5*	5.6*	18*	56*	180*	560*	1.8K*	5.6K*	18K*	56K*	180K*	560K*	1.8M*	5.6M*
1.8*	6.2	20	62	200	620	2.0K	6.2K	20K	62K	200K	620K	2.0M	6.2M
2.2*	6.8*	22*	68*	220*	680*	2.2K*	6.8K*	22K*	68K*	220K*	680K*	2.2M*	6.8M*
2.4	7.5	24	75	240	750	2.4K	7.5K	24K	75K	240K	750K	2.4M	7.5M
2.7*	8.2*	27*	82*	270*	820*	2.7K*	8.2K*	27K*	82K*	270K*	820K*	2.7M*	8.2M*
3.0	9.1	30	91	300	910	3.0K	9.1K	30K	91K	300K	910K	3.0M	9.1M
3.3*	10*	33*	100*	330*	1K*	3.3K*	10K*	33K*	100K*	330K*	1.0M*	3.3M*	10M*
3.6	11	36	110	360	1.1K	3.6K	11K	36K	110K	360K	1.1M	3.6M	12M*
3.9*	12*	39*	120*	390*	1.2K*	3.9K*	12K*	39K*	120K*	390K*	1.2M*	3.9M*	15M*
4.3	13	43	130	430	1.3K	4.3K	13K	43K	130K	430K	1.3M	4.3M	18M*

GODBOUT sells VECTOR STUFF:

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

THEIR FAMOUS WIRE PENCIL & new SLIT-n-WRAP

WITH TOOL, 500' OF WIRE, AND INSTRUCTIONS.

Every now and then, someone comes up with something that makes breadboarding a lot easier... like solderless breadboard strips or Vectorboard. The VECTOR WIRE PENCIL is one of the best breadboarding/prototyping aids we've seen. It uses a special wire whose insulation melts on contact with sufficient heat; this allows a good solder connection. Simply loop the wire around your various leads as it comes out of the tool--apply a spot of solder at the connection---and you've got a soldered connection. Eliminates cutting and stipping...great!

$9.50
+1 lb postage

AS REVIEWED IN POPULAR ELECTRONICS, RADIO-ELECTRONICS, and other magazines.

AND BOBBINS

We have replacement wire bobbins for the wire pencil. 250' of wire per bobbin; specify RED, GREEN, BLUE, or CLEAR. THREE BOBBINS (YOUR CHOICE OF COLOR): **$2.40**

The VECTOR P180 "SLIT-N-WRAP" tool is a revolutionary tool that provides---for the first time---a speedy manual wrapping device which supplies insulated wire from a spool directly to wire wrap posts without external prestripping or precutting! It also can do this in a "daisy-chain" fashion so that more than one level is rarely required, so wrap posts can be shorter for greater board stacking density. THIS TOOL DOES FOR WIRE WRAPPING WHAT THE WIRE PENCIL DOES FOR BREADBOARDING.

$24.50
+2 LBS SHIPPING

Also available: replacement wire, 3-100' spools for $2.75, and the P185 adapter ($1.25), which allows you to use the SLIT-N-WRAP with our Hobbywrap tool. Wire color choice: RED, GREEN, BLUE, CLEAR.

THE SLIT-N-WRAP TOOL COMES COMPLETE WITH INSTRUCTIONS AND 2-100 FOOT SPOOLS OF WIRE.

Tie Down Thingys

20 TIE DOWNS/$2.40. When you do long wire runs with the wire pencil, you might want some tie down posts to keep the wires close to the circuit board. Well, here they are. Mounts on .1" centers.

VECTORBOARD

VECTOR type 169P84-062, pre-punched epoxy-glass with holes on .1" centers---perfect for ICs. 8½" x 17", 1/16" thick. This board works well with the wire pencil to give you fast prototypes. $8.95 + 1 lb shp.

T112-2 CLIPS

So you've got a universal prototype board, with power and ground lines running parallel to a bunch of ICs. How do you connect the IC pins to the power line? You could use a glop of solder but these little clips are better. **100 clips/$1.95**

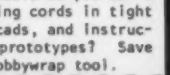
AND OTHER SPECIAL ITEMS

HOBBYWRAP TOOL

$41.95

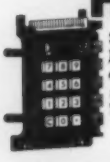
If the high cost of wire wrapping equipment puts you off, check out our HOBBYWRAP tool. You get the tool (rechargeable so you don't have to deal with trailing cords in tight places), bit, charger, nicads, and instructions. Why solder your prototypes? Save time and effort with our Hobbywrap tool.

SPST PUSHBUTTON SWITCHES



Momentary contact. **4/$1**

KEYBOARDS

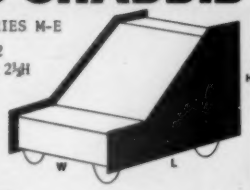


$2.95 EA. Non-multiplexed keyboard with 18 keys and on-off switch. One terminal of each switch common bussed.

2/$1.95 Multiplexed type, suitable for calculators & other applications. You receive 1 keyboard as illustrated, along with an identical model that has no printing on the keys.

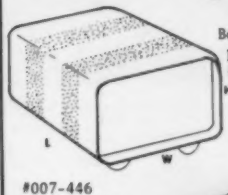
LMB CHASSIS

SERIES M-E



M-E #462
6W x 4L x 2½H
$5.80

M-E #7114
11W x 7L x 4H
$10.39



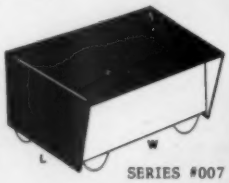
Body gray, front panel dark gray & recessed.

#CO-4
8L x 10W x 5H
$13.62

#007-446
4L x 4W x 6½H
$5.08

#007-746
4L x 7W x 6½H
$6.30

#007-946
4L x 9W x 6½H
$7.09



SERIES #007

We also carry two other popular LMB boxes. These are small, hammertone gray painted units.

"M00" minibox (2⅛ x 1½ x 1 3/8") $0.86
#139 minibox (5½ x 3 x 1½") $1.85

CHERRY

Cherry Switch
Stock #M61-100

Light action data switches at a popular price: **5/$1.95!**

Switch/keytop combination: **5/$2.35**
KEYTOPS WHILE THEY LAST...sorry, no choice of keytop legend.

PLANTRONICS HEADSET

HAMS---CBers---Pilots--Switchboards--Telephone systems: these are comfortable, light, and tough. Built-in mic amp. Complete and ready to go. **$59.95 EACH.**

MICROPHONE

Tired of built-in condenser mics on your tape recorder that pick up hum and motor noise as well as you? This mic comes with over 20' of cord, and is lightweight and rugged. **$6.95 EA, or 2/$13.00.**

GODBOUT stocks KITS, KITS and KITS

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

POWER SUPPLY KITS

12V 8A
$22.50 + 7 LBS SHIPPING — LESS CASE, HARDWARE.

ONE OF OUR MOST POPULAR KITS, EVER SINCE ITS INTRODUCTION. IT'S IDEAL FOR HAMS AND CBERS, SINCE IT POWERS MOBILE EQUIPMENT IN THE HOME; BUT IT'S ALSO A HIGH-POWER, ACCURATE BENCH SUPPLY, OR A POWER SOURCE FOR AUTOMOTIVE EQUIPMENT (TAPE PLAYERS ETC.). BETTER THAN .05 VOLT REGULATION; CURRENT LIMITING UP TO 13A; ADJUSTABLE OUTPUT 11-14V, SHORT PROTECTION, RF BYPASSING.

1/2 AMP
$7.95 + 2 LBS SHIPPING

REGULATED, SHORT-PROOF, THERMALLY LIMITED. HALF AN AMP CONTINUOUS, OR 1 AMP INTERMITTENT. SAVE YOURSELF THE HEADACHE OF DESIGNING YOUR OWN; LET US COLLECT THE PARTS AND SAVE YOU MONEY TOO. SPECIFY 5, 6, 8, OR 12 VOLTS. LESS CASE AND HARDWARE.

experimenters

$10.95 + 2 LBS SHIPPING

This kit provides dual tracking, regulated voltages from under ½V to over 18V, with up to 200 ma of current capacity per side. The regulator IC used for this supply gives short circuit protection as well as thermal protection, which is most handy when you're using a supply on the bench and subjecting it to all kinds of slipped test probes and other hazards. Less case, hardware.

± 15 VOLTS

$9.95 + 2 LBS SHIPPING

A MEDIUM CURRENT (150 MA PER SIDE) SUPPLY, SIMILAR TO OUR VARIABLE EXPERIMENTER'S SUPPLY AND DESIGNED FOR ECONOMY AND STABILITY. USES A DUAL TRACKING REGULATOR; SHORT CIRCUIT PROOF AND THERMALLY LIMITED. GREAT FOR OP AMP AND MUSIC SYNTHESIZER CIRCUITS. KIT DOES NOT INCLUDE CASE OR HARDWARE.

son-of-a cheap clock

$14.50 + 1 LB SHIPPING

If you're looking for an easy-to-build and reliable 6 digit clock, look at ours. You get .3" digits for less eyestrain, segment and driver transistors for brighter digits, sockets for the IC and readouts, and a complete set of parts...including transformer and circuit board. Our easy to follow data sheet tells how to implement several options, such as blanking the display, battery operation, how to use the clock in your car, and so on. Less case & hardware.

ACTUAL SIZE DIGIT

$15.95 Kevin's clock +1 LB.

Kevin Fischer (one of our unsung Tech heroes) has come up with an alarming clock kit, & we wanted to offer it to you as a kit. Here's what it does: gives the time of day, displayed on 4 HALF-INCH DIGITS (something for our myopic clock fans); has sleep and alarm functions, as well as a snooze function so you can postpone the alarm another 9 minutes. ALSO - we've added an opto-isolator to the alarm out pin, so you can drive a triac for AC control of not only your radio, but a toaster or something else. We include EVERYTHING except case, and that means 7 pushbutton switches for the various functions, and a speaker to give an alarm tone from the internal oscillator!

a time base and a universal oscillator

$10.50 ppd

*We've redesigned our popular 60 Hz time base...and here are the results: **Use with ANY Statek crystal (see elsewhere for listing of crystal frequencies). Now you can generate a wide variety of precision timing signals, not just the 60 Hz required for field use of digital devices. **Operates from 7 to 27 VDC, with an internal regulator for a stable circuit. **Output can swing between supply voltage or +5 VDC. In this mode it can drive 2 standard TTL loads. **Board size has been considerably reduced, making it easier to mount in a variety of units. So, all in all our time base now represents more than just a micropower source of 60 Hz signals...it's a universal oscillator board with a load of applications. For frequencies other than 60 Hz out, specify the Statek crystal you would like us to include with your kit.*

MORE, ASK ABOUT OUR MUSIC KITS

HERE'S EVEN MORE TOYS AND THINGAMAJIGS

RELAYS

These miniature relays have 5V coils for logic use, and contacts rated at 1A or 10 watts; maximum voltage is 200V. Used in our cassette interface board. **$1.75**

tiny rotary switch
3/$2.95

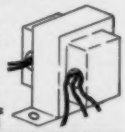
1 pole, 7 position + off. For programing & other applications.

ASSORTMENT

6 assorted photoresistors.....6/$1.95
10 assorted thermistors.....10/$1.95
3 24V DC solenoids.....3/$1.95
2 mini reed relays, 3000 ohm coil 2/$1.00
RESISTOR ASSORTMENT #2 --- over 300 ¼ watt units, leads cut & formed for PC.....$1.95

ADD 1 LB SHP.

Our popular transformer is back in stock after a short vacation. 24V center-tapped, 600 ma current. **$1.95 EACH.**



transformer

speakers

We now have 2 types of speaker for you:

1. (Illustrated) 2" dynamic speaker. For acoustic couplers, toys, radios, etc. **3 FOR $2.50**

2. Standard 4" speaker, **2/$1.75**

ADD ONE LB POSTAGE PER ORDER.

CLM 6000

This opto-isolator contains an LED and wide-range photo resistor in a tiny, opaque package. **$3.50 EACH.**

antenna

THREE for $2.00 Good experimenter item; use for inductive pickup, transistor radio antenna, etc.

ADD 1 LB to WIRE ORDERS

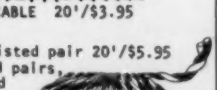
WIRE

19 conductor, color-coded

RIBBON CABLE 20'/$3.95

Twisted pair 20'/$5.95

15 twisted pairs, yellow and black



SENTRY CRYSTALS-- $4.95 PER CRYSTAL

CRYSTALS

Series mode, fundamental, wire leads, for hams and computer bugs. Choose from 4 MHz (PACE clock crystal), 5 MHz 8 MHz, 10 MHz, 12 MHz, 15 MHz, 18 MHz (8080 clock crystal), and 20 MHz.

battery connectors

These are for 9 volt transistor radio type batteries. Color-coded 7" leads. **FIFTEEN CONNECTORS FOR $1.95**

GODBOUT ANNOUNCES OUR NEWEST IMSAI/ALTAIR 8800 PLUG IN COMPATIBLE PERIPHERAL:

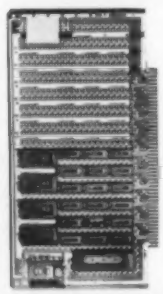
ECONORAM™

4K x 8 $99.95

We took everything we learned from selling 4K x 8 RAM boards for the past year, added some of this year's circuit tricks, and came up with ECONORAM --- a memory board that is even more remarkable due to its low price. We've engineered this with the user in mind, giving you several benefits:

* 3 regulators to share power load, plus optimized thermal design, means a cooler running microcomputer
* Typical current consumption of under 1A gives your power supply a break
* Fast --- Zero wait states
* All TTL support ICs are latest Low Power Schottky types
* For reliable and unambiguous data transfer, all addresses, data lines, and outputs are buffered for minimum loading and maximum output capability
* Power-on clear included

All these features are packed on to an Altair-sized, industrial quality double-sided PC board, with sockets for all ICs, 7 tantalum capacitors for power supply decoupling, and plenty of bypass capacitors---39 of them, in fact, as well as a logic print and instructions. ASSEMBLED/TESTED UNITS ALSO AVAILABLE FOR A SURCHARGE; write for quotations and specify quantity.



new from VECTOR!

Universal Prototype Board $19.95 +1 lb shp

This is one of the neatest Altair accessories we've seen. It accepts virtually any size IC package, has a power and ground plane on opposite sides of the board for extra capacitance. Room for 4 regulators, 1 heat sink provided with board. By the way, the sockets are shown only for illustration, but they get the point across that you can stuff a lot of ICs on here --- implement your own memory boards, I/O boards, etc.

MicroMONITOR $29.95

We've taken the 5204, a 4K EROM, and programmed it with some software for your 8080. With this software, you may:

**Examine and fill memory
**Punch and read paper tape
**Branch to, and recover from, programs.

Our package consists of the programmed 5204 as well as a complete software listing.

PACE PACKET $2.50

Learn about PACE, the 16 bit microprocessor chip, with this 80 page booklet. Contains detailed and specific information on the chip itself, software, system organization, and more. Also includes 11" X 17" fold-out logic print of PACE implementation.

GROUP DISCOUNTS: COMPUTER CLUB MEMBERS MAY WISH TO POOL THEIR ORDERS. BUY 10 KITS, TAKE 10%; BUY 100, TAKE 20%.

"EconoRom" $159.95

ALTAIR 8800/IMSAI PLUG-IN COMPATIBLE. This is a 4K by 8 EROM board...the ideal place for putting software, be it assembler, editor, or any custom set of routines. Additionally, this board may expand to 8K x 8 by simply adding more sockets and EROMs; also available is a 2K x 8 version if you don't need a full 4K. LOW POWER: 8K board requires ½A @ 5V, & 150 ma @ -12V. Buffered addresses for lightest loading, buffered outputs for maximum drive. Kit includes sockets, double-sided quality PC board, on board regulators, logic print, and instructions. Program it yourself, or have us do the programing.

8K X 8 BOARD $249.95 2K X 8 BOARD $115.00

8080 Software Board $159.95

We took our ECONOROM board kit, but instead of including blank EROMs, these are programmed with assembler, editor, & monitor routines for the 8080. This is a valuable first step if you're trying to get away from machine language programing. There's not really enough room here to fully describe all the functions of the software...but if you send us $2.95 (refundable with order), we'll send you our software packet that includes instructions listing, schematic, and assembly data.

Smart Cassette Interface $96

ALTAIR 8800/IMSAI PLUG-IN COMPATIBLE

It's pretty well assumed that the way to low cost, high storage memory is cassette memory. But how do you interface to the cassette, and what's more important, how can you make it simple to use and flexible?

Our cassette interface talks to 2 cassette machines, so you can read and write when required; it has an option to talk to a third machine, so you can do sort-and-merge memory operations...has room for a general purpose, I/O port consisting of a hi-current, hi-Z transceiver, 8 bit latch, and handshaking signals...but most important of all, all this is under software control included on the board in EROM. The EROM gives the "smarts" you need to make cassette interfacing a snap. This board is one of the most useful peripherals you can buy for a small computer system, but we'll have a hard time proving that in this little space. If you want more info, send $4.95 and we'll send you documentation including logic print, an annotated listing and an instructions listing, and a guide to using the interface, including a description of the "Kansas City" hobbyist standard. OPTION PRICES:

EXTRA CASSETTE CHANNEL.....add $6.00
I/O PORT HARDWARE IMPLEMENTATION.....add $6.00
TTY/RS-232 INTERFACE.....add $12.00

Microcomputer $44.95 POWER SUPPLY

While designed for JOLT systems, this power supply will also power your 8008, 8080, 6800, etc. Gives 5V @ 5A, +12V @ ½A, -12V @ ½A, and an adjustable negative bias supply. Crowbar overvoltage protection included on +5V.

Same size board as JOLT power card; will run the JOLT CPU plus four of our NAKED RAM boards.

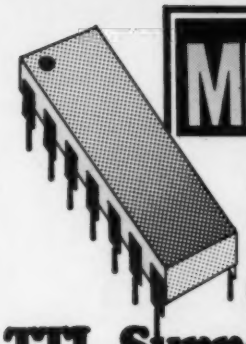
Includes everything except the line cord; that means the case and heat sink too. ADD POSTAGE FOR 8 POUNDS.

4K x 8 Naked $79.95 RAM

This 4K by 8 memory board has no frills, just storage. Designed for compatibility with JOLT systems, this board is also ideal for other microcomputers using bi-directional buss systems. Same size as JOLT memory card, plus low-power operation (750 ma) to keep you on good terms with your power supply.

If you don't need the onboard regulation or address/data buffers of our "Bigger Brother" 4K board, then this is the way to go.

Sockets included for all ICs.



MICROPROCESSORS plus SUPPORT ICs, MEMORIES

TTL Support ICs

8093 Quad 3-state buf, separate enable..$0.63
8094 Same but "0" gives hi Z state.....0.63
8095 Noninv 3-state buf, NOR enable.....0.63
8096 Inv 3-state buf with NOR enable.....0.63
8097 Noninv 4-2 3-state buf, sep. enable 0.63
8098 Inv 4-2 3-state buf, separate enbl..0.63
8131 6 bit buss comp.; hiZ ins, hyster...2.50
8202 10 bit buffer register.....1.10
8233 2 in, 4 bit muxer; noninv data path 0.75
8234 2 in, 4 bit muxer; inv data path....0.75
8241 Quad exclusive OR.....0.25
8242 Quad exclusive NOR.....0.25
8250 Binary to octal decoder.....0.55
8251 BCD to decimal decoder.....0.55
8266 2 input, 4 bit multiplexer.....1.00
8267 2 input, 4 bit multiplexer.....1.00
8271 Four bit shift register.....0.98
8280 Same as 74176.....0.98
8544 Quad switch debouncer, 3-state outs 0.90
8831 Quad non-diff/dual diff 3-state dvr 2.25
8833 Quad 3-state trnscvr; noninv rcvr...1.90
8835 Quad 3-state trnscvr; inv rcvr.....1.90
8836 Quad NOR unified buss receiver.....3.95
8837 Hex unified buss driver w/ hyster...1.85

MEMORIES

1702A	2K EROM	$14.95
2101	1K static 4X256	2.95
2102	1K static RAM	1.95
2111	Equiv 2112, 18 pin DIP	2.95
2112	4 X 256 RAM	2.95
2533	1024 bit shift reg.	1.00
5202	2K EROM	9.95
5203	2K EROM	9.95
5204	4K EROM	17.50
5600	8 X 32 PROM. Same as 8223, programs differently	2.50
5610	Same but open collec.	2.95
7489	64 bit RAM	2.23
74206	256 bit RAM open col.	5.90
93410	Bipolar 256 bit RAM--similar to 74200, but faster	2.00

PROGRAMMING SERVICES

We are set up to program EROMs, such as 1702s, 5203s, 5204s, etc. (but not PROMs like the 8223). Cost is $7.50/IC, or $35/10 ICs. If you wish to have EROMs on any of our kits re-programmed, we can do so at a discount (write for details). Call our 24 hour phone line to request hexadecimal coding forms.

8 BIT CHIP SETS

NOTE: These chip sets come with ICs & pinout sheet

8008 CHIP SET $32.50

(1) 8008 CPU (8) 2102s

8080 CHIP SET $59.95

(1) 8080 CPU (8) 2102s (1) 5204 ROM

16 BIT CHIP SETS

NOTE: Both chip sets include PACE DATA PACKET

PACE CHIP SET $125

(1) PACE CPU (4) DS3608 (1) DS0026
(1) DM8837 (2) 5204 ROMs

DELUXE PACE SET $195

(1) PACE CPU (4) DS3608 (1) DS0026
(1) DM8837 (32) 2102s (4) 5204 ROMs

GODBOUT TERMS AND NEWS

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

FIRST OF ALL, HAPPY BIRTHDAY U.S.A.!

TERMS, DISCOUNTS, SHIPPING...

Add 50¢ to orders under $10. If we indicate weight on a product, include sufficient postage for that weight. Otherwise, all items are shipped postpaid. Any excess postage will be refunded. ADDRESSES: We prefer your street address, as we send out our packages via UPS and they cannot deliver to a PO box (unless, of course, you live in one). DISCOUNTS: The flyer lists discounts where applicable; if you order quantities of one item figure your own discounts. If you are part of, say, a club and wish to pool orders for quantity purchases, write us with your needs and we'll give you a quote.

CREDIT CARD ORDERS, CODs, PHONE LINE...
415-357-7007

If you have Bankamericard® or Mastercharge® orders, you may place them via our answering service. It is active 24 hours a day for those of you who wish to call at off-peak hours to save money on phone bills. Please remember that this is an order desk ONLY and cannot answer technical questions or requests for information other than those that relate to orders. No COD orders, it's too much hassle.

WARRANTIES ETC.

If there's one thing we've learned, it's that a satisfied customer is the single most important asset of any company...so we want you to be happy. Any defective items will be replaced if you send back the defective item (we cannot be responsible for user-inflicted injuries, but we generally give you the benefit of the doubt). If upon assembly of a kit you feel it does not live up to our claims, we will replace, refund, or repair depending upon your wishes.

PROBLEMS AND VARIOUS GREMLINS...

From time to time we encounter problems - lost shipments, illegible handwriting with no address given, a misprint, that sort of thing. If you have any problems with us or an order, WRITE IT DOWN and send to PROBLEMS DESK, c/o Bill Godbout Electronics. We'll get on it right away.

REPAIRS

If something goes haywire with your kit, we have a repair service. Describe your problem first and we'll see if we can troubleshoot via the mail; if that doesn't work, bundle it up good with a description of the problem and send to REPAIRS DEPT, c/o Bill Godbout Electronics.

WELCOME TO THE CLUB, GEORGE MORROW...

George Morrow, our ace computer kit designer, has opened up his own shop (Morrow's Micro-Stuff, Box 6194, Albany, CA 94706)...which is good news for computer fans. George will be mostly selling low volume items and esoteric/unusual/new parts, so all you hardcore computer fanatics should have a good outlet for hitherto hard-to-find items. Send for his flyer, and tell him we sent you.

NOTE FROM CAVE GRAFIX...

Hi! We've been doing Bill's ads and flyers for over a year now, and one of the reasons we're still here is due to your favorable comments and support of our admittedly unusual ad style. THANK YOU! We will do our best to keep you not only informed of the latest items and prices, but entertain you at the same time. Again, thanks for your support...we really appreciate it.

GODBOUT HAS LOTS OF SEMICONDUCTORS!

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

IC DISCOUNT SCHEDULE: BUY 10, TAKE 10%; BUY 100, TAKE 20%

high number TTL

74273	8 BIT LATCH (20 PIN)	1.89
74365	NONINV 3-ST BUF NOR EN	.63
74366	INV 3-STATE BUF NOR EN	.63
74367	NONINV 4-2 BUF W/SEP EN	.63
74368	INV 4-2 BUF W/SEP ENBL	.63
74390	16 PIN DUAL DEC CNTR	1.50
74393	14 PIN DUAL BINRY CNTR	1.50

MISC. ICs

FLYER SPECIAL--95H90 HIGH SPEED PRESCALER.....$10.50

5739	*4 function calculator*	*$ 1.50*
8T97	HEX BUSS DRIVER	$ 1.45
74L04	Low power hex inverter	$ .20
93L11	Same as 74L154	$2.75
5370	4 digit alarm clock	$ 4.50
MCT-2	Optical Isolator	2/$ 1.00
75492	MOS TO LED HEX DIGIT DRIVER	.80

***For computer oriented ICs and microprocessors, see our computer page.

TRANSISTORS

2N2221 Si NPN unmarked..... TO-18 7/$1.00
2N2222 Si NPN may be unmarked... TO-18 5/$1.00
2N3904 Si NPN house numbered.... TO-105 7/$1.00
2N3906 Si PNP house numbered.... TO-105 6/$1.00
2N4249 Si PNP...TO-106 5/$1.00
2N4250 Si PNP...TO-106 5/$1.00
2N5135 Si NPN general purpose... TO-106 10/$1.00

D41D1 Si PNP 1.5A max..... TO-220 3/$1.00
Complementary Pair---5A I_C max; H_{FE} @ 3A 40 min; 40V..... TO-220 pr/$1.50

Lo Power Schottky

74LS00	.36	74LS139	1.38
74LS02	.36	74LS155	1.38
74LS04	.42	74LS157	1.25
74LS10	.36	74LS160	1.85
74LS20	.36	74LS161	1.85
74LS30	.36	74LS162	1.85
74LS37	.53	74LS163	1.85
74LS38	.53	74LS168	1.87
74LS74	.56	74LS169	1.87
74LS132	1.50	74LS175	1.35
74LS138	1.38	74LS273	2.65
74LS367	1.00		

FIELD EFFECT TRANSISTORS

Dual N JFET VHF/UHF amp .....3/$1.00
N JFET VHF/UHF RF amp sim to 2N4416.....3/$1.00
Dual N JFET very lo noise audio preamp....2/$1.00
N JFET general purpose.....4/$1.00
---all above FETs in TO-18 type case---
CLOSEOUT: FET plug-in replacement for 6AK5 tube. Limited quantity.....$1.00

Standard TTL CATALOG PAGE 6

7400	.18	74155	.71
7401	.18	74156	.90
7402	.18	74157	.71
7403	.18	74159	1.50
7404	.20	74160	.89
7405	.20	74161	.89
7406	.36	74162	.89
7407	.36	74163	.89
7408	.23	74164	1.34
7409	.23	74165	1.34
7410	.18	74173	1.34
7411	.23	74174	1.52
7413	.71	74175	1.34
7414	.70	74176	.98
7416	.36	74177	.98
7417	.36	74179	.75
7420	.18	74180	.98
7422	.23	74181	2.23
7425	.36	74182	.80
7426	.25	74190	1.34
7427	.26	74191	1.34
7430	.18	74192	1.34
7432	.27	74193	1.34
7437	.36	74194	1.34
7438	.36	74195	.71
7439	.45	74196	.98
7440	.18	74197	.98
7441	.98	74198	1.96
7442	.80	74199	1.96
7445	.63		
7446	1.34		
7447	1.34		
7448	1.34		
7450	.18		
7451	.18		
7453	.18		
7454	.18		
7460	.18		
7461	.18		
7472	.32		
7473	.36		
7474	.36		
7475	.80		
7476	.36		
7483	.89		
7485	1.60		
7486	.36		
7489	2.23		
7490	.80		
7491	.98		
7492	.98		
7493	.71		
7495	.98		
7496	.98		
74100	1.34		
74107	.36		
74121	.45		
74123	.71		
74125	.71		
74126	.71		
74143	5.00		
74145	.89		
74150	1.07		
74151	.71		
74153	.80		
74154	1.25		

CMOS

4000	.25
4001	.25
4002	.25
4006	1.50
4007	.25
4008	1.10
4009	.45
4010	.45
4011	.25
4012	.25
4013	.50
4014	1.50
4015	1.10
4016	.55
4017	1.25
4018	1.50
4019	.55
4020	1.50
4021	1.45
4022	1.20
4023	.25
4024	.95
4025	.25
4026	1.50
4027	.65
4028	1.00
4029	1.35
4030	.45
4033	1.50
4035	1.25
4037	.50
4040	1.50
4041	.85
4042	.85
4043	.60
4044	.60
4047	1.50
4049	.50
4050	.50
4116	.60

LINEARS

301M	OP AMP	.30
304T	NEGATIVE VOLTAGE REGULATOR	.75
305T	POSITIVE VOLTAGE REGULATOR	.75
307H	OP AMP	.35
308M	OP AMP	1.00
309T	+5 VOLT REGULATOR	1.00
309K	+5 VOLT, 1A REGULATOR	1.25
311M	VOLTAGE COMPARATOR	1.00
311T	VOLTAGE COMPARATOR	1.00
316H	HI INPUT 2 OP AMP	2.50
318H	FAST OP AMP	1.00
320/12K	-12 VOLT, 1A REGULATOR	1.25
320/12T	-12 VOLT, HALF AMP REG.	1.25
320/15K	-15 VOLT, 1A REGULATOR	1.25
324D	QUAD OP AMP	1.50
339D	QUAD COMPARATOR	1.50
340/5K	+5V 1A REGULATOR	1.25
340/5T	+5V HALF AMP REGULATOR	1.75
340/6T	+6V HALF AMP REGULATOR	1.75
340/8K	+8V 1A REGULATOR	1.75
340/8T	+8V HALF AMP REGULATOR	1.75
340/12K	+12V 1A REGULATOR	1.95
340/12T	+12V HALF AMP REGULATOR	1.75
340/15K	+15V 1A REGULATOR	1.85
340/15T	+15V HALF AMP REGULATOR	1.75
340/18K	+18V 1A REGULATOR	1.75
340/18T	+18V HALF AMP REGULATOR	1.75
340/24K	+24V 1A REGULATOR	1.75
340/24T	+24V HALF AMP REGULATOR	1.75
373D	AM/FM/SSB IF DETECTOR	1.95
377H	DUAL 2 WATT AUDIO AMPLIFIER	2.50
380M	MINIDIP 380	.95
380D	2W AUDIO AMP	1.45
381D	DUAL LO NOISE PREAMP	1.65
382D	STEREO LO NOISE PREAMP	1.65
531M	HI-SLEW OP AMP	1.25
540H	AUDIO POWER DRIVER	1.95
555M	TIMER	.60
556D	DUAL TIMER	1.25
565D	PHASE LOCKED LOOP	1.25
566M	VCO/TRIANGLE SQUARE OUT	2.10
567M	TONE DECODER/PLL	2.50
703H	LOW POWER RF/IF AMP	.75
723D	PRECISION REGULATOR 150 MA	.50
723H	PRECISION REGULATOR 150 MA	.60
725H	INSTRUMENTATION OP AMP	2.00
733H	VIDEO AMP	1.50
741M	OP AMP	.30
741H	OP AMP	.35
747D	DUAL 741 OP AMP	.50
748M	OP AMP	.35
1458	SEE 5558M	
1496D	BALANCED MODULATOR/DEMOD	1.25
1556M	PREMIUM OP AMP	1.00
1558	SEE 5558M	
1596	SEE 1496D	
3026D	TRANSISTOR ARRAY	1.25
3065D	TV SOUND SYSTEM	.75
3086D	TRANSISTOR ARRAY	1.25
3900D	QUAD OP AMP NORTON TYPE	.50
4131M	HIGH GAIN OP AMP	.50
4136D	QUAD LO NOISE OP AMP	1.50
4194D	50 MA ± TRACKING REGULATOR	1.50
4194TK	200 MA ± TRACKING REGULATOR	2.50
4195M	50 MA ±15 VOLT REGULATOR	1.25
4195TK	200 MA ±15 VOLT REGULATOR	2.25
4250H	PROGRAMMABLE OP AMP	1.00
4739D	DUAL LO NOISE OP AMP	1.00
4741M	DUAL 741 OP AMP	.50
5556M	SEE 1556M	
5558M	DUAL 741 OP AMP	.55
8038D	VCO SINE/SQ/TRI FUNC GEN	4.50

· Dick Whipple
305 Clemson Drive
Tyler TX 75701

John Arnold W5CUD
RFD 4, Box 52A
Tyler TX 75701

Inexpensive Paper Tape System

--using 5 level tape with computers

Serious program development requires the use of nonvolatile mass storage of some type. Cassette tape systems are popular among computer hobbyists, and for good reason. Cassettes are convenient, inexpensive, and provide a high density medium for mass storage. Much has appeared in the literature concerning cassette recording techniques. The use of punched paper tape for mass storage has not been adequately treated, although it is readily available to hobbyists interested in Baudot equipment. Paper tape is not nearly as fast or as dense as cassette tape, but it ranks high in convenience and reliability. Programs can be stored on individual strips of tape and labeled for later use.

The Model 19 Teletype comes with a 5 level paper tape punch and reader. The punch is mechanically linked to the keyboard, so tape must be punched by hand. The keyboard and punch can be physically removed from the printing unit and used separately. The punch magnet requires a 100 volt at 1 Amp supply. The tape reader on the Model 19 is called a Transmitter-Distributor, or "TD" for short. A punched tape is drawn through one portion at a time, and a mechanical parallel to serial conversion produces the correct teletype (TTY) signal. The tape is read at 60, 65, or 75 words per minute, as determined by a gear set inside. The TD is usually connected in series with the keyboard contacts, so that either can be used to generate TTY signals. This is a satisfactory arrangement for computer operation.

With Model 19 equipment alone, you will not be able to make paper tapes under computer control. For this capability you will need a Model 14 Typing-Reperforator. The Model 14 accepts standard Baudot TTY signals and punches a corresponding paper tape. In addition to

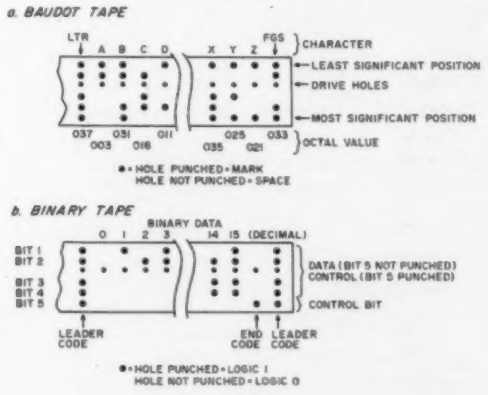


Fig. 1. (a) Conventional Baudot paper tape as used in communications service. (b) Binary paper tape for use in computer applications.

DATA CODE		CONTROL CODE	
Octal	Baudot Equivalent	Octal	Baudot Equivalent
000	<BLANK>	020	<T>
001	<E>	021	<Z>
002	<LF>	022	<L>
003	<A>	023	<W>
004	<SPACE>	024	<H>
005	<S>	025	<Y>
006	<I>	026	<P>
007	<U>	027	<Q>
010	<CR>	030	<O>
011	<D>	031	<B>
012	<R>	032	<G>
013	<J>	033	<FGS>
014	<N>	034	<M>
015	<F>	035	<X>
016	<C>	036	<V>
017	<K>	037	<LTR>

Table 1.

Fig. 2. Reading and punch program: Model 19 and Model 14.

TAG	MNEMONIC	ADDRESS	CODE	EXPLANATION
TREAD*	LXI SP	000123	061	Load the stack pointer
		000124	377	SP (LOW)
		000125	003	SP (HIGH)
	LXI H	000126	041	Load HL with memory load address
		000127	xxx	Low part of address
		000130	xxx	High part of address
LOOP2	LXI B	000131	001	Preset B to 2 and C to 0
		000132	000	
		000133	002	
LOOP1	PSH B	000134	305	Save B and C
	CALL	000135	315	CALL INPUT ROUTINE
		000136	000	INPUT (LOW)
		000137	000	INPUT (HIGH)
	POP B	000140	301	Restore B and C
	CPI	000141	376	Check for end of tape
		000142	020	<T>
SELF	JZ	000143	312	Form tight loop for end
		000144	143	SELF (LOW)
		000145	000	SELF (HIGH)
	JNC	000146	322	Ignore other control codes
		000147	134	LOOP1 (LOW)
		000150	000	LOOP1 (HIGH)
	ADR C	000151	201	First Pass: get least 4 bits
	RLC	000152	007	Second Pass: get highest 4 bits
	RLC	000153	007	
	RLC	000154	007	
	RLC	000155	007	
	MOV C, A	000156	117	
	DCR B	000157	005	Check for second pass
	JNZ	000160	302	Jump back for second pass
		000161	134	LOOP1 (LOW)
		000162	000	LOOP1 (HIGH)
	MOV M,A	000163	167	Store byte in memory
	INX H	000164	043	Increment to next memory location
	JMP	000165	303	Jump back for new byte
		000166	131	LOOP2 (LOW)
		000167	000	LOOP2 (HIGH)
TPUNCH**	LXI SP	000170	061	Load the stack pointer
		000171	377	SP (LOW)
		000172	003	SP (HIGH)
	MVI B	000173	006	Load B with leader count
		000174	036	30 decimal
LOOP1	MVI A	000175	076	Load A with <LTR>
		000176	037	<LTR>
LOOP1	CALL	000177	315	CALL TAPEOUT ROUTINE
		000200	273	TAPEOUT (LOW)
		000201	000	TAPEOUT (HIGH)
	DCR B	000202	005	Decrement Leader count
	JNZ	000203	302	Jump back for more Leader
		000204	175	LOOP1 (LOW)
		000205	000	LOOP1 (HIGH)
	LXI H	000206	041	LOAD Starting Address in HL
		000207	xxx	Low part of Address
		000210	xxx	High part of Address
	LXI D	000211	021	LOAD Ending Address in DE

punching, it prints the incoming characters in "ticker tape" fashion. You may wonder how it prints on a tape full of holes. Nothing extraordinary here: The paper tape is chadless (that is, the holes are not punched all the way through). By the way, Model 14s come in a less expensive non-typing version, also. If you already have printer capability, this would be a good choice. Model 14s of both types are readily available on the surplus market.

The Model 14 can easily be connected into the computer I/O system. Since it accepts standard TTY signals, it may be connected in series with the selector magnets of the Model 19 printer.

Paper tapes can be punched with two basic formats: Baudot and binary. Baudot tapes record the 5 level Baudot code in five hole positions across the width of the tape. Actually, there is a sixth smaller hole (called the "sprocket" hole), but it is only used for drive purposes. With the Baudot system, a "hole" is regarded as a "mark" and a "no hole" as a "space." The orientation of the code is shown in Fig. 1. Baudot format is that used for communication purposes.

Unlike Baudot, the binary format is not in common use. In such tapes, the five hole positions are used to record 5 data bits. A "hole" represents a logic 1 and a "no hole," a logic 0. The hole position corresponding to the least significant bit is indicated in Fig. 1.

In a computer environment, Baudot paper tapes are useful for recording programs written in a high level language such as BASIC. Binary tapes, on the other hand, find greatest utility in preserving machine language programs. This is accomplished by simply punching in tape an image of the memory area containing the program. The program can later be re-entered into the same area of memory by reading the paper tape with the proper software. The discussions which follow deal primarily with punching and reading binary tapes under computer control.

The Altair 8800 and similar minicomputers have a basic word length of eight bits. Since a paper tape can record only 5 bits at a time, two read cycles are required to input the full data word. In this case, one bit of the five can be set aside for control purposes, still leaving the required eight bits with two read cycles. Bit 5 is used for the control function in our system. When bit 5 is not punched, the remaining four hole positions are considered binary data representing half of an eight bit data word. The next character in the tape without a control punch is regarded as the second half of the data word. When bit 5 is punched, the remaining four bits represent a control code. Fifteen possible codes can be used to control various aspects of the reading program. In our system, one such code is used as the leader at the beginning of the tape and another serves to indicate the end of the tape.

		000212	yyy	Low part of Address	END	MVI A	000246	076	Load A with stop code <T>
		000213	yyy	High part of Address			000247	020	
	MOV A, H	000214	174	Check for end of Load		CALL	000250	315	CALL TAPEOUT ROUTINE
	CMP D	000215	272	Compare High Address			000251	273	
	JNZ	000216	302	If not same, Jump to CONT			000252	000	
		000217	226	CONT (LOW)		MVI B	000253	006	Load B with Leader count
		000220	000	CONT (HIGH)			000254	120	
	MOV A, L	000221	175		LOOP2	MVI A	000255	076	Load A with <LTR> for Leader
	CMP E	000222	273	Compare Low Address			000256	037	<LTR>
	JZ	000223	312	If same, Jump to END		CALL	000257	315	CALL TAPEOUT ROUTINE
		000224	246	END (LOW)			000260	273	TAPEOUT (LOW)
		000225	000	END (HIGH)			000261	000	TAPEOUT (HIGH)
CONT	MOV A, M	000226	176	Get memory byte into A		DCR B	000262	005	Decrement Leader count
	CALL	000227	315	CALL TAPEOUT ROUTINE [Special]		JNZ	000263	302	If not finished, Jump back to LOOP2
		000230	271	TAPEOUT [Special] (LOW)			000264	255	LOOP2 (LOW)
		000231	000	TAPEOUT [Special] (HIGH)			000265	000	LOOP2 (HIGH)
	MOV A, M	000232	176	Get memory byte again into A	SELF	JMP	000266	303	Jump to SELF to end
	RLC	000233	007	Reposition upper four bits			000267	266	SELF (LOW)
							000270	000	SELF (HIGH)
	RLC	000234	007		TAPEOUT [Special]	ANI	000271	346	Mask off upper four bits
	RLC	000235	007						
	RLC	000236	007				000272	017	
	CALL	000237	315	CALL TAPEOUT ROUTINE [Special]	TAPEOUT	PSH B	000273	305	Save B
						PSH A	000274	365	Save A
		000240	271	TAPEOUT [Special] (LOW)		CALL	000275	315	CALL OUTPUT ROUTINE
		000241	000	TAPEOUT [Special] (HIGH)			000276	042	OUTPUT (LOW)
							000277	000	OUTPUT (HIGH)
	INX H	000242	043	Increment to next memory byte		POP A	000300	361	Restore A
						POP B	000301	301	Restore B
	JMP	000243	303	Jump back to AGAIN		RET	000302	311	Return to calling program
		000244	211	AGAIN (LOW)	* TAPE READ PROGRAM				
		000245	000	AGAIN (HIGH)	** TAPE PUNCH PROGRAM				

Other uses can be made of the control code as well. Suppose you wish to send the computer a 16 bit memory address. You could prefix the four data characters with a special control code that would cause the reading program to branch to an appropriate subroutine. Table 1 gives the data and control codes both in octal and their Baudot equivalent.

As further illustration, consider the implementation of paper tape on our Altair 8800 system. A Model 19 TD is series connected with the keyboard and a Model 14 is series connected with the selector magnets of the printer. We chose two control codes: 037 octal for the leader and 020 octal for the end of the tape. As previously indicated, two character positions are required to store the contents of one memory location. The first contains the least significant four bits while the second contains the most significant four bits. If the leader is encountered within data, it is ignored. This makes it possible to correct a bad punch by simply overpunching with all holes.

The programs we use to punch and read binary paper tapes are given in Fig. 2. The punch program requires the beginning and ending addresses of the memory area that is to be stored on tape. The read program needs only the beginning address, since the end is signalled by an 020 punch.

The punch program is used in the following manner: The beginning and ending addresses to be dumped to tape are placed at 000207 and 000212, respectively; location 000170 is examined; and the RUN switch is toggled. The program generates a number of 037s for the leader. The contents of consecutive memory locations are then punched. At the end of the tape, an 020 octal is punched, followed by an additional leader. Final termination of the program occurs in a tight loop (i.e., an unconditional jump to itself). At this point, the STOP switch may be toggled.

The tape reader program is used in the following way: The address where the tape is to begin storing data is loaded at 000127; location 000123

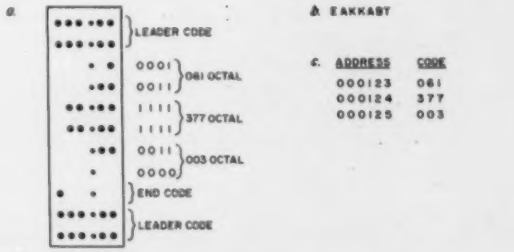


Fig. 4. (a) Binary paper tape made by punch program. (b) Printout of modified version of punch program. (c) Memory area used for sample run.

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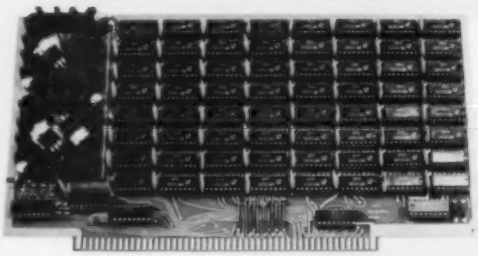

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is examined; and the RUN switch is toggled. After execution has begun, the TD is started with the tape in the beginning leader. When the program is finished, the front panel light pattern will change as a tight loop is entered. STOP may then be toggled. The program or data should be correctly stored in memory.

In the event you have a Model 19 punch and TD but not a reperforator, you can still make programs by hand. Fig. 4 is a software modification that outputs Baudot characters to the printer as they should be punched by hand. The program supplies automatic carriage returns and line feeds. A "Z" is printed at the end of each line so that SPACEs may be detected. You will note in Table 1 that data codes include CR, BLANK, and LF (line feed). These would either confuse the printout or not be printed, so the modification software makes the following substitutions:

B is printed for BLANK
L is printed for LF
X is printed for CR

Use the procedure outlined above for punching tape with the modification program loaded at 000271. The characters to be punched will be output to the printer in order. Then use the printout to hand punch the paper tape. A button on top of the punching unit can be used with the LTR key to punch all holes for error correction. When making the tape, be sure to use the LTR key to make the leader. This manual way of making a paper tape is quite tedious, but it will allow you to become familiar with the binary tape system. Fig. 4 shows a paper tape punched by the Model 14 under computer control. Also shown is the printed output of the modified punch program corresponding to the same memory data. ■

TAG	MNEMONIC	ADDRESS	CODE	EXPLANATION
TAPEOUT [Special]	ANI	000271	346	Mask off upper four bits
		000272	017	
TAPEOUT	CPI	000273	376	Check for <BLANK>
		000274	000	<BLANK>
	JZ	000275	312	If so, Jump to PRNTB
		000276	313	PRNTB (LOW)
		000277	000	PRNTB (HIGH)
	CPI	000300	376	Check for <LF>
		000301	002	<LF>
	JZ	000302	312	If so, Jump to PRNTL
		000303	316	PRNTL (LOW)
		000304	000	PRNTL (HIGH)
	CPI	000305	376	Check for <CR>
		000306	010	<CR>
	JZ	000307	312	If so, Jump to PRNTX
		000310	321	PRNTX (LOW)
		000311	000	PRNTX (HIGH)
	LXI D	000312	021	Dummy: Skip instruction
PRNTB	MVI A	000313	076	Place <B> in A
		000314	031	<B>
	LXI D	000315	021	Dummy: Skip instruction
PRNTL	MVI A	000316	076	Place <L> in A
		000317	022	<L>
	LXI D	000320	021	Dummy: Skip instruction
PRNTX	MVI A	000321	076	Place <X> in A
		000322	035	<X>
	PSH B	000323	305	Save BC
	CALL	000324	315	CALL OUTPUT ROUTINE
		000325	042	OUTPUT (LOW)
		000326	000	OUTPUT (HIGH)
	POP B	000327	301	Restore BC
	LDA	000330	072	Place COUNT in A
		000331	364	COUNT (LOW)
		000332	000	COUNT (HIGH)
	INR A	000333	074	Increment COUNT by one
	STA	000334	062	Store in COUNT
		000335	364	COUNT (LOW)
		000336	000	COUNT (HIGH)
	ANI	000337	346	Check for end of line
		000340	077	
	RNZ	000341	300	Return if not
	MVI A	000342	076	Place <Z> in A
		000343	021	<Z>
	PSH B	000344	305	Save BC
	CALL	000345	315	CALL OUTPUT ROUTINE
		000346	042	OUTPUT (LOW)
		000347	000	OUTPUT (HIGH)
	MVI A	000350	076	Place <CR> in A
		000351	010	<CR>
	CALL	000352	315	CALL OUTPUT ROUTINE
		000353	042	OUTPUT (LOW)
		000354	000	OUTPUT (HIGH)
	MVI A	000355	076	Place <LF> in A
		000356	002	<LF>
	CALL	000357	315	CALL OUTPUT ROUTINE
		000360	042	OUTPUT (LOW)
		000361	000	OUTPUT (HIGH)
	POP B	000362	301	Restore BC
		000363	311	Return to Calling program

Fig. 3. Modification for Model 19 system only.

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Gain for Your HT

--a half wave whip ?

After buying a two meter hand-held transceiver which came supplied with only a helically wound flexible antenna, I decided to try a full length ¼ wave antenna to see if it had any advantage compared to the "rubber ducky." A temporary ¼ wave antenna was quickly made using a 19 inch piece of wire attached to an antenna connector. Although the "rubber ducky" had performed very well, and had the advantage of being compact, the longer antenna seemed to have the advantage of greater capture area and additional height. The improvement on both receiving and transmitting was indeed noticeable.

Since better communications is the name of the game, this little experiment led me to think that if a full length ¼ wave antenna showed some improvement, then perhaps an extended length antenna would provide additional gain. Catalogs listed a wide selection of telescoping antennas for use in services outside the two meter band which could easily be modified. These come in assorted lengths and diameters, but the extremely long ones were ruled out as being unsuitable because they were too unwieldy for a hand-held set. Besides, there would be some difficulty in obtaining a good impedance match to the set.

Three of the shortest ones were selected as being best suited for modification. These had the dimensions shown in Table 1.

With the proper antenna connector (in my case an F-59), and a small loading coil to present a reasonably good match to the output of the transceiver, it is quite simple to modify any one of these antennas for two meter use. In each case a 2-1/2 inch length of 1/2 inch OD, 3/8 inch ID polystyrene tubing is used at the antenna base to enclose the coil and to insulate the antenna from the grounded shell of the connector. All coils are wound with number 20 AWG wire on a piece of plastic tubing 1-1/4" long by 5/16 inches in diameter. If soft plastic tubing is used for the coil form, the wire will hold tight and it will be easy to slip the polystyrene cover over it. For antenna A, wind 13 turns to cover the length of the form; for antenna B, wind 17 turns; and for antenna C, wind 19 turns. Spacing along the length of the coil is not critical.

ANT.	BASE DIAMETER	COLLAPSED LENGTH	EXTENDED LENGTH
A	3/8"	5-7/8"	43"
B	3/8"	4-5/8"	39"
C	5/16"	5-7/8'	36-1/2"

Table 1.

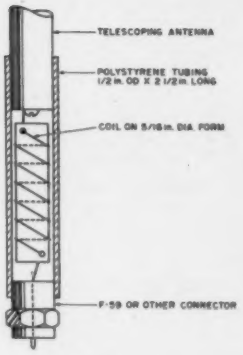


Fig. 1.

One end of the coil is attached to the base of the antenna (all telescoping antennas used came with a small machine screw in the base). The polystyrene cover is then placed over the coil so that about 3/4 inch of the antenna base is inside the cover. The coil cover is held in place with epoxy cement. When the epoxy has cured, attach the other end of the coil to the antenna connector (F-59, BNC, etc.), and cement the connector to the coil cover. Although not essential, a 3 inch length of shrink tubing placed over the coil cover and antenna base will add to the appearance and help to strengthen the polystyrene tubing.

All these extended length antennas have exhibited a remarkable improvement over the "rubber ducky," and a fair amount of gain over the ¼ wave whip. This has been most noticeable when working simplex over a range that could not be reached with the "rubber ducky" or the full length ¼ wave antenna. As I have said before, the name of the game is better communications, so anything that can be done to enhance the low power of most hand-held transceivers is well worth the effort. ■

73 Magazine *Staff*

The Super Transmatch

--match almost anything!

The transmatch type of antenna matching network has proved to be one of the most popular designs for transmitter to transmission line coupling or for direct transmitter to antenna coupling. It will match a wide variety of load impedances, including reactive as well as resistive loads. This article describes several modifications to this network which further increase its usefulness, and various construction techniques which bypass the problems which may exist when one tries to economically purchase the components needed for the network.

Why Use a Matching Network?

Many amateurs do not use a matching network between their transmitter and antenna transmission line, particularly when feeding coaxial line from a transmitter with a pi-network output circuit. If the transmission line has an absolutely flat swr of 1:1, a matching network does not add much (e.g., to a 52 Ohm transmission line working from a transmitter output designed for 52 Ohms). The matching network, being a tuned circuit, will only add a bit more of harmonic suppression, much like a simple low pass filter. But, most transmission lines do not have absolutely flat swrs of 1:1 over the entire frequency range of an antenna. This is particularly true for thin wire dipoles or other resonant antennas used on the low frequency bands, or for the various types of trap or loaded antennas when operation over an entire amateur band is considered. It could easily happen, depending on the antenna type, that the swr is 1:1 at a particular operating frequency within a band and rise to 3:1 or 4:1 at the band edges. The result is that the transmitter will not load properly into these high swrs and reduced power output will occur.

The use of a matching network will allow the transmitter to load properly at any frequency within a band, but it will not change the swr on the transmission line. It cannot do the latter since the swr is dependent upon how closely the transmission line impedance matches the impedance at the antenna terminals. The antenna terminal impedance varies, of course, with frequency, while the transmission line impedance remains fixed. So, why bother with a matching network? Simply because the transmitter can be loaded to full power output into the transmission line. A certain percentage of the output power will still be lost due to the swr, but that percentage remains *fixed* due to the swr – and more overall power will be radiated!

Most amateurs are still using tube-type transmitters, but it is interesting to note that as more solid state transmitters and even solid state linears appear on the market, transmitter to transmission line matching is going to become much more critical. Most solid state power amplifiers, even in the HF ranges, employ broadband interstage and output circuits. They require no tuning, but they will deliver maximum power output only when connected to a resistive load with a very low swr. Even swrs of the range of 1.5:1 or 2:1 will severely reduce power output. Since most HF antenna/transmission line setups do not provide a completely flat swr over the extremes of every band, it means that a matching network will usually be required between the transmitter and transmission line. In a sense, the tuning controls that one now associates with the output stage of a transmitter will be transferred to an external matching network.

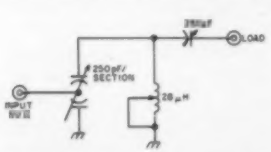


Fig. 1. Basic transmatch for 80-10 meters.

The Basic Transmatch

The circuit of the basic transmatch is shown in Fig. 1. With the values shown, it will work from 80-10 meters and match a reasonably wide range of load impedances, be they a transmission line or an antenna directly. If a balanced transmission line or antenna is used, the output of the transmatch can be coupled to the load via a standard 1:1 or 1:4 toroid unbalanced-to-balanced transformer. The rating of the components used depends, of course, upon the power level involved, and can range from receiver-sized components for the QRP level to 3/16" spaced variable capacitors for the 2 kW PEP level. Tuning is accomplished by the use of an swr bridge between the

matching network and the transmitter. On any given operating frequency, the capacitors are tuned to establish a 1 to 1 swr with a minimum amount of inductance being used. Several settings of the capacitors and inductance can achieve a perfect match, but only the one with *minimum* use of inductance will provide a good match plus the most efficient transfer of power through the matching network. The components can be scaled down if operation over less than the 80-10 meter range is desired. For 40-10 meter operation, a 15 microhenry inductor will suffice. For 20-10 meter operation, the inductor can be 10 microhenries and each section of the capacitors need be only a 100 uF.

Circuit Variations

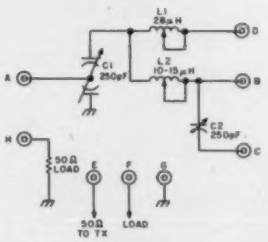
The basic transmatch circuit as described above has been in use by many amateurs for several years. However, its ability to match even a wide range of loads can be further improved and the circuit can be configured to allow the choice of several matching network forms with the same number of components or with the addition of just one more component. The modified transmatch is particularly useful for coupling to extremely short antennas or to highly reactive loads, while still retaining the use of components of reasonable size.

The modified transmatch is shown in Fig. 2. An additional inductor of 10-15 microhenries has been added and access points provided to more circuit components. Flexibility is provided by bringing the access points to binding posts and also by having the SO-239 connectors for the transmitter and transmission line (or antenna) brought to a binding post.

Jumpers between the binding posts, which can be grouped in any convenient configuration, provide interconnection. Conventional transmatch operation is provided by having the input to A, D grounded, and the load to C and L2 set for zero inductance. With very short antennas which the above configuration cannot match properly, the load is connected to B instead of C and L2 increased to provide proper loading. The network can be used as a form of pi-network by leaving D ungrounded, connecting the load to B and grounding C. Interchange of the input and output terminals (A and B) can also be tried. A conventional L matching network can also be formed. If one is working into a lower impedance than the transmitter output, C is grounded, the input goes to B and the load is connected to D. If working into a higher impedance, the input (transmitter output) goes to D and the load to B. A T matching network is formed by having A grounded, the input going to D and the load connected to B. Simple capacitive divider circuits can be formed in several ways (e.g., by grounding A, setting L1 and L2 to minimum, connecting the input to C and the load to D).

Several other circuit configurations can be arranged, and with patience just about any conceivable load can be matched. Obviously with such an array of matching circuit configurations available, it becomes important to avoid confusion. Post H provides a dummy load. The transmitter, if it has output tuning controls, is first connected to the dummy load and loaded properly. The drive can then be reduced to just enough to properly operate the swr meter connected between the transmitter and matching network. Various matching circuit configurations can then be tried, with the goal in mind to find one that provides a 1 to 1 swr and which utilizes a *minimum* amount of inductance in the matching network. This will take some patience at first (or when using a new antenna), but the settings of the components and connection points can be logged to expedite future tuning. When the transmitter drive is increased to normal level, some slight retuning of the settings of the components in the matching network will be required.

Fig. 2. Modified transmatch provides a variety of matching network configurations and greater matching range.



The Components Struggle

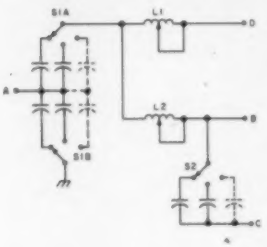
For QRP levels and powers up to about 50 Watts, regular BC type variable capacitors are usable. The inexpensive $1.29 types with teflon sheet insulation between the plates work quite well, and can be used to construct a truly compact matching network. Roller inductors are not necessary. B&W coil stock (3002 or similar) tapped every few turns can be used, or a coil can be easily home brewed using any plastic form of ½-¾" diameter and winding it with #16 wire. Handbook formulas can be used to determine the turns and spacing needed for the inductance values given. Another possibility is to wind #18 wire on an Amidon T-106, mix 2, toroid. About 40 turns are required for 28 microhenries and about 30 turns for 15 microhenries. Every few turns should be tapped. The combination of the BC variables and toroid coils makes a good combination for a QRP matching network to be housed in a very small metal or plastic enclosure, not only because of size, but because the toroids are highly self-shielding.

For the 50 to 200 Watt power level, one can, under the circumstance of not having to match extremely reactive loads, still use BC air-insulated variable capacitors and either coil stock, a home brew longitudinally wound coil, or a toroid wound coil. A suitable toroid for the latter would be Amidon T-200, mix 2, and it can be wound with #14 wire with the turns mentioned above. This would probably be the best approach to use if one were confronted with an antenna system which produces a fairly moderate matching problem (swrs in the order of 3 to 1 or 4 to 1), such as a thin wire dipole not loading properly into a transceiver over the entire limits of the 80 or 40 meter band.

However, if one wanted to have a matching network at the 50-200 Watt level which would just about load into anything going, including a 12' whip on 80 meters, a different approach has to be used. The variable capacitors should be rated at least at from 1000-1500 volt spacing. The inductors should be the roller type. Suitable such components, if purchased new, can be quite expensive. A better bet would be to find suitable components from a surplus outlet. Fair Radio Sales, for instance, frequently has available suitable capacitors and surplus roller inductors from the old ARC-5 transmitter series.

The 200 Watt-on-up power level presents a particular problem. It is difficult to believe that at this power level one would need a matching network to load into any sort of random antenna configuration. Again, for a moderate swr environment and the 1 kW power level, probably the components specified for the

Fig. 3. Fixed capacitors can replace costly variables for high power operation. See text for details.



extreme of the foregoing power level will suffice — 1000 to 1500 volt rated variable capacitors and surplus ARC-5 roller inductors. However, if one does wish to build a 2 kW level matching network that will literally load into any sort of odd antenna system, either a brute force approach can be used or a modified one. The brute force approach is rather simple. The variable capacitors should be wide-spaced and rated at 3,000 to 6,000 volts. The variable inductors should be Johnson type 229-203 or similar. The inductors are available from surplus outlets.

The capacitors present a different sort of problem. Although some 6,000 volt wide-spaced capacitors are available (from sources such as Fair Radio Sales or Barry Electronics, NYC), they are expensive ($25 range) and also consume a great deal of space. A modified approach to constructing a matching network for the 200-2000 Watt level can be used to save on capacitor costs. C1 can consist of a modest 100 pF section wide-spaced variable, as can C2. Additional capacitors can then be plugged in or switched in across C1 and C2 in 50 uF steps, so their total capacitance can be brought up to 250 uF. Note that to build up C1 only a single capacitor across it is needed, not a separate capacitor across each section of C1. Another variation of the above theme which has been tried and which does work is to eliminate the variable capacitors altogether. Plug in or switched in capacitors (5,000 volt mica types) are used as shown in Fig. 3. It would be desirable to have as many plug in capacitors as possible to simulate the variables, but one should at least have enough to form 50 uF steps up to 250 uF and one or two below 50 uF. If one knows what antennas the matching network will be used with on the various bands, a small variable can first be used, with low power, in the matching network, to establish the approximate value of the fixed capacitors for full power operation. With fixed capacitors, the variable inductors are used to tune for a match. L2 should always be used in series with C2. Probably a bit more inductance will be used than with having variable tuning capacitors. This will reduce the efficiency of the network a bit (and also, the fixed capacitors have more loss than air-spaced capacitors). With good quality components, however, and heavy strapping to interconnect components, the loss should be hardly discernible.

This article has tried to present some ideas for adding more versatility to an already good matching network. Many construction techniques are possible at the various power levels, and by careful catalog and parts box searching, one should be able to build the network economically. ■

Note: Dennis Hoffman, 1291-A Garden Terrace, Fort Dix NJ 08640, has available Johnson 28 uH kW level roller inductors at $15, and 10 uH inductors for $10 postpaid.

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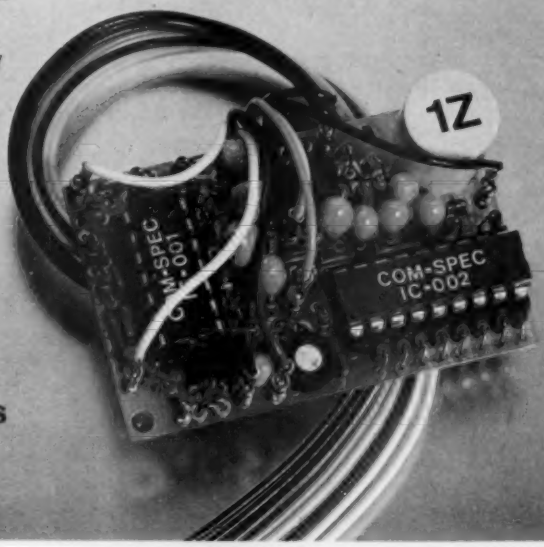
$59.95

K-1 field replaceable, plug-in, frequency determining elements

$3.00 each



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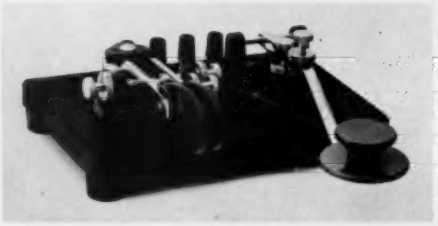

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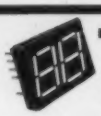
.5 in. High. The Best on the market. Ideal for large readout application. $4.95



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One of our best readouts .5 in. high, 20mA per segment. Common anode. $3.75

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Red, .30 in. high 15mA per segment. Common anode.... $1.25

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2N3906 PNP Compl. 2N3904		0.15
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THE KING FEATURES:

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3) Single 12v. supply and a minimum of interface components
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Kit No. 70250-1Y (Yellow readout)
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Kit No. 70250-3R (FND807 readout). $29.50

All kits include components, PC Boards, Transformer, case, and construction manual.

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7453 - .16	74175 - 1.39	4019 - .59	4049 - .59
7473 - .37	74181 - 2.75	4020 - 1.59	4050 - .59
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PC Board for 70250.....		$ 4.25
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75492	-	digit driver..... $ 0.45
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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554
FCC 76-214
39630

In the Matter of
Deregulation of Part 97 of the Commission's Rules to provide for greater flexibility in the administration of examinations in the international Morse code

ORDER

Adopted: March 9, 1976;
Released: March 16, 1976

By the Commission:

1. The Commission intends by this Order to allow greater flexibility in the administration of examinations in the international Morse code in the Amateur Radio Service. We are deleting that part of Section 97.29(c) of the Commission's Rules concerning the standard to be met by an applicant in the reception by ear and transmission of the international Morse code.

2. Section 97.29(c) of the Rules currently provides that in order to pass the examination in reception of the international Morse code, the applicant must copy and send one minute of plain text "at not less than the prescribed speed, free from omission or other error for a continuous period of at least 1 minute during a test period of 5 minutes . . ."

3. We believe Section 97.29(c) to be unduly restrictive. While the Commission is required by Article 41, §3 of the Radio Regulations of the International Telecommunications Union to license as amateurs only those persons proving they are able to send correctly by hand and to receive by ear texts in Morse code signals (this requirement may be waived for stations making exclusive use of frequencies 144 MHz and above), the manner in which such proof may be offered is not specified.

4. There are several alternatives to the current method of proving competency in the reception of the Morse code, and the Commission believes it to be in the public interest for it to have the option of utilizing one or more of these alternate methods. Among the possibilities we are seriously considering is a multiple choice examination covering a five minute transmission of plain text. Such a test would relieve the applicant of the extremely tedious burden of copying one minute of mixed text without error, yet would provide an accurate gauge of his competency in the reception of Morse code message content.

5. The Commission is planning to begin administration of multiple choice "message content" telegraphy examinations on a limited, trial basis in the near future in a few Commission field offices. All applicants appearing at field offices administering this type of examination will be required to undertake it. Such applicants will not be afforded the option of taking the more traditional examination. As a matter of policy during this experimental period, we will certify those applicants taking multiple choice examinations only if they have answered 80 per cent of the questions correctly. Those applicants taking the traditional examination will continue to be required to copy and send one minute of a five minute transmission perfectly in order to pass. Any change in this policy will be announced publicly in advance of the change.

6. Authority for this amendment appears in Section 4(i) and 303 of the Communications Act of 1934, as amended. Because the manner in which examinations in the Amateur Radio Service are conducted is a matter of internal agency procedure, the prior Notice and public procedure provisions of the Administrative Procedure Act, 5 U.S.C. §553(b), are not applicable.

7. Accordingly, IT IS ORDERED, that Part 97 of the Commission's Rules IS AMENDED as set forth in the attached Appendix effective March 24, 1976.

FEDERAL COMMUNICATIONS COMMISSION
Vincent J. Mullins, Secretary

APPENDIX

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is amended as follows:

1. §97.29(c) is amended to read as follows:

§97.29 Manner of conducting examinations.

* * * * *

(c) The code test required of an applicant for an amateur radio operator license, in accordance with the provisions of §§97.21 and 97.23 shall determine the applicant's ability to transmit by hand key (straight key or, if supplied by the applicant, any other type of hand operated key such as a semi-automatic or electronic key) and to receive by ear, in plain language, messages in the international Morse code at not less than the prescribed speed during a five minute test period. Each five characters shall be counted as one word. Each punctuation mark and numeral shall be counted as two characters.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554
FCC 76-228
39639

In the Matter of
Amendments of Parts 2 and 91 of the Commission's Rules and Regulations to permit assignment of frequencies in the 420-450 MHz band for non-Government radiolocation.

Docket No. 20147
Report and Order
Adopted: March 10, 1976
Released: March 16, 1976

By the Commission: Commissioner Washburn absent.

1. On August 23, 1974, the Commission released a Notice of Proposed Rule Making (FCC 74-882) in the above-captioned matter proposing the allocation of frequencies in the 420-450 MHz band for non-Government radiolocation service on a secondary basis to Government and Amateur services presently operating in that band. The Notice was duly published in the Federal Register on August 29, 1974 (39 FR 31533). Comments were due by November 4, 1974, and reply comments, by November 19, 1974.

2. The proposal in the Notice was in response to the rule change as stated above, requested by Navigation Management, Inc. (NMI).[1] This request was prompted by the

Continued on page 164

[1] A company engaged in the development and manufacture of radiolocation equipment in this band.

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Frequency Counter..... Kit 012 + Kit 030 + Kit 016 +Time Base
RPM Counter..... Kit 012 + Kit 030 + Kit 020 + Kit 018

KIT 016 FREQ. COUNTER

Features FET input front end with trigger circuit for measuring complex waveforms. Measures from 0.1Hz to 10MHz when used with Kit 015 or 019. Measures from .01Hz to 35MHz when used with Kit 013 and 014. **$24.50**

KIT 017 DVM

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Counts from 1 to 100,000 RPM. RPM counter kit contains components and PC board. **$9.95**

KIT 030 POWER SUPPLY

*Input voltage: 25V max. *Output current: 1 amp max. *Load regulation: 50mV. *Output voltage: 5V. *Line regulation: .01%. (requires 8-20V transformer) **$4.55**

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Kit 015 50Hz or 60Hz chain time base using line frequence as reference. Accuracy 0.1-0.05%. Outputs 10Hz-1Hz-0.1Hz. Complete with CMos shaping circuit and PC Board..... **$9.75**

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Kit 018 60Hz chain time base using line frequence for Kit 020 RPM counter.

*Outputs: .6 sec. = 100th of RPM
6 sec.= 10th of RPM
60 sec. = full revolution

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One chip 4 digit decade counter kit, with both 7 segment and BCD output.

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3. Transfer, reset, count, blanking and true compliment control inputs.
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SOCIAL EVENTS

from page 17

LEVELLAND TX
AUG 1

The 11th Annual Northwest Texas Emergency Net swapfest and picnic will be held in the City Park in Levelland, Texas on Sunday, August 1, 1976. Bring your own picnic basket. Free registration begins at 0900. Lunch at 1230. Swapping all day. Tables are provided. This event is for the entire family and is jointly sponsored by the Hockley County Amateur Radio Club and the Northwest Texas Emergency Net. Mobile talk-in frequency is on two meters only on 146.28-88 Mc., the Levelland Repeater: WR5AFX.

WASHINGTON MO
AUG 1

The Zero-Beaters ARC will hold their annual hamfest on Sunday, August 1, at Washington, Missouri City Park. Free parking, auction, and bingo for the XYLs. No admission fee or fee for parking in the traders row. Many prizes including station accessories, books and a handmade quilt. For info or tickets contact Al Lanwermeyer WNØQBS, or Zero-Beaters ARC, WAØFYA, Box 24, Dutzow, Mo. 63342.

MACK'S INN ID
AUG 6-8

The Wyoming - Idaho - Montana - Utah Ham Club would like to announce that the 44th Annual WIMU Hamfest will be held August 6-8 at Mack's Inn, Idaho just 20 miles west of Yellowstone National Park. There will be a full line of activities including our famous breakfast under the pines. Camping on the grounds is available plus motels, cabins and restaurants. Pre-registration is $6 per person, $1 for children under twelve. For registration or more info contact: WIMU, c/o Larry Jacobs WA7ZBO, 5655 So., 4060 West, Salt Lake City, Utah 84118.

SAUK RAPIDS MN
AUG 8

The St. Cloud Radio Club Annual Hamfest will be held on Sunday, August 8, 1976, from 10 am till closing, at the Sauk Rapids Municipal Park. Free parking and overnight parking, hot dogs and pop available. Swapfest and ham gear sale. Talk-in on 34/94 and 3925. Hope to see you all there. For further info, contact Bill Zins WAØOTO, St. Cloud Radio Club, PO Box 752, St. Cloud MN 56301.

FT. WASHINGTON STATE PARK PA
AUG 8

The Mt. Airy VHF Radio Club (the Packrats) are holding their annual family picnic in the Flourtown Area of the Fort Washington State Park on Sunday, August 8, 1976 (rain date 15 August). Talk-in via W3CCX/3 on 52.525, 146.52, and 222.98/224.58 MHz.

PETOSKEY MI
AUG 14

Straits Area Radio Club Swap and Shop will be held August 14 from 8 am to 4 pm at Emmet County Fairgrounds on US 31, ½ mile west of southern junction of US 31 and US 131, in Petoskey, Michigan. All amateurs, CBers, SWLs, $1 admission, 50¢ per table, door prizes, lunch counter, free parking. Talk-in on 3.920 MHz, channel 1, 146.52 MHz.

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LETTERS

ou goons don't ever proofr
I insist that you print ev

from page 51

For three years, on Good Friday, I made the trip to the FCC office in Detroit. In the first two tests, I did not pass the code. The third time I passed the code, but was so excited about passing the 13 wpm that I messed up the sending.

Coming home a little discouraged, I realized that I had been doing a lot of other things and not really devoting enough time to my studying. I went out and bought an HW-101 because by now I was determined to get my General.

I listened to W1AW almost every night. Nights that I couldn't listen because of other commitments, I listened to code records. On April 20, 1975, I took my General Exam through the Civil Service Commission in Cleveland.

After two minutes of code copy, I could see that I had enough characters. I was so happy to have copied them, I quit copying, thinking I had enough to pass the test requirements. When I received my test results, I was disqualified for not copying for the full five minute period – but was given credit for my theory.

On June 24, I retook my 13 wpm code test and passed. After waiting four months, I called the FCC field office in Detroit and was told a four to six months' wait was not uncommon due to all the CB license applications Gettysburg has had. When six months were up, I called Detroit again. A woman gave me a Washington, D.C. number to call.

Washington told me that they had no record of my application and that it must be lost, and I would have to resubmit a new Form 610. So I got on the phone to Detroit again to get a new Form 610 sent to me. I talked to an examiner this time and he gave me the name of someone in Washington to talk with about getting special authorization to go on the air since I already had my Technician call.

I was told to send a Xerox copy of the filled out 610 which Detroit was sending me and they would see what they could do.

I sent the new application to the FCC in Detroit, and a copy to Washington, on December 23, 1975. Four weeks later, I received a temporary license good for four months; four weeks later, I received my regular General; and four and one half weeks after that, the lost license showed up (March 19, 1976) – a total of 38½ weeks and three licenses.

The second thing to go wrong happened two weeks before my license was due to arrive. I had a fellow "ham" come over to fire up my rig to see if it and my antenna system were working. Well, the rig, which had been aligned by a Heath Service Center a year before, wouldn't load up.

So, after looking at the rig for a week, I took it back to the Service Center. Seven weeks later (March 5, 1976), I got my rig back, finding out that it had a shorted capacitor in the VFO which burnt out a resistor. Total cost was $45.00 service and $.30 parts.

The third thing to go wrong, and I hope the last, happened on March 5. I had 30 feet of tower blow over, which I had only installed three days earlier (I was waiting for the weekend in order to install 20 more feet of tower with guides). One good thing was that I didn't have my 20 meter beam on it yet.

I realized that when I poured the footer, I threw pieces of broken sidewalk into the hole for fill. I had a hinge plate mounted with 9" bolts. There was also a large piece of cement just below the mounting bolts. At this point, the concrete broke and the tower came down.

That following weekend I dug a new hole and poured a new footer. This time I did not use any large pieces of old concrete and had three foot rods welded to my bolts, with cross braces welded to them.

The whole point of my letter is to encourage others not to give up, but "just hang in there." I feel that in conquering some of these "road blocks" encountered while participating in the hobby of ham radio we can learn new things, become a better person, and acquire new friendships. Also, when it is all over, we can look back and laugh at our mistakes and learn from them.

Richard L. Harben WB8FFZ
Sheffield Lake OH

FIREBIRD A. R. C.

I am interested in contacting amateurs who are currently working for, or have retired from, the General Motors Corporation. My search is for hams who do not know of the Firebird Amateur Radio Club.

My list of Firebird units (different locations) stands at 190 and I am striving for the 200 mark.

The Firebird Club presents 100 free 5 color QSL cards to all new members.

Ray Cunningham WA8OKE
9102 Nathaline
Detroit MI 48239

CONTESTS

from page 10

be made within two years after the contest, but not before the results are published. The fee for each certificate is DM 5 or 8 IRCs. EURD III is given for written confirmations (QSLs) from at least 20 different countries and a minimum of 100 prefix points. Countries are determined by the European countries list shown below, and each country counts only once regardless of band. Each official European prefix, however, counts one prefix point per band. EURD II is given for 150 prefix points in 30 countries and EURD I is given for 200 prefix points in 40 countries.

EUROPEAN COUNTRY LIST:

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Send application, QSLs, and fee to: DAFG, Award Manager, PO Box 1663, D – 4140 Rheinhausen, West Germany.

WORKED ALL SVARA AWARD

The Saginaw Valley Amateur Radio Association now offers the Worked All SVARA Award, which can be had by sending five QSL cards from members of SVARA and one dollar to cover the cost of printing and mailing to the Secretary of SVARA, WB8KFU, 2115 West Sloan, Burt MI 48417. The QSL cards will be returned with the certificate. Contacts must be made during 1976.

DRD AWARD

This award is offered by the DAFG to promote amateur RTTY activities and is issued each year (Jan 1st to Dec 31st). The DRD requires a total of 25 points for stations outside Germany, where each QSO with a German RTTY station counts 1 point (or 2 points on VHF/UHF). Each German station may be worked once on shortwave and once on VHF/UHF, and only 25 points per band may be claimed. No QSLs are needed. Send a summary of your log, confirmed by two radio amateurs or your radio club. The fee is DM 5 or 8 IRCs. Send application, QSLs, and fee to: DAFG e.V., Award Manager, PO Box 1663, D – 4140 Rheinhausen, West Germany.

RESULTS

RESULTS OF 1975 MARTS SEANET WORLDWIDE DX CONTEST

SEANET Area Top Scorers:

Single band – Phone	9V0SN	188,421 points
Multiband – Phone	9V0SH	530,784
Single band – CW	VS5PM	14,418
Multiband – CW	9M2LN	153,537

Outside SEANET Area Top Scorers:

Single Band – Phone	LU2AFH	4,293 points
Multiband – Phone	IT9FKS	5,400
Single Band – CW	OH1QB	609
Multiband – CW	YZ4HA	1,386

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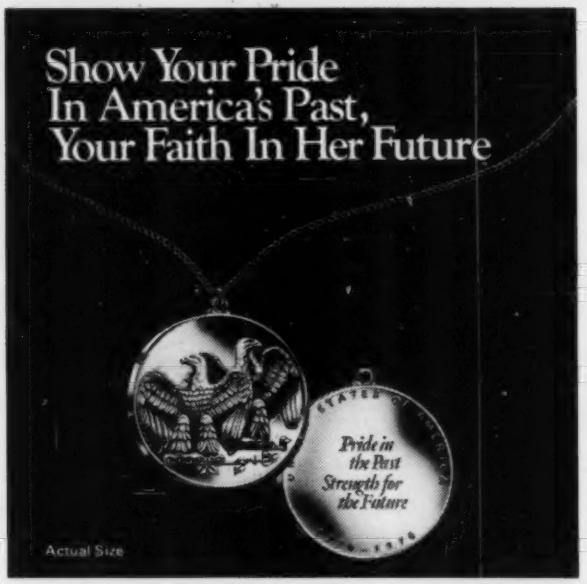

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Simple VHF Monitor

-- converter for a transistor radio

This little converter, when used with an inexpensive portable transistor radio, will monitor a wide range of VHF frequencies. It can be built in a few minutes using junk box parts. Even if the parts have to be bought, they will cost only a few dollars. It doesn't provide communications receiver quality, but it is useful when tuning up a transmitter or for general coverage reception. It mounts next to the ferrite loop of the transistor radio to make up a complete receiving system. Reception over a wide range of frequencies is possible by altering the tuning coils. The components specified here cover the range of about 120 to 150 MHz. This range provides a lot of fun in listening to aircraft radio communications, the 2 meter ham band, and other services.

The circuit, Fig. 1, is that of a regenerative converter. The incoming signal, tuned by the tank coil L-1 and capacitor C-2, is mixed in the transistor with an oscillator frequency controlled by L-3 and C-7. The difference frequency is adjusted to fall in the standard broadcast band.

The converter is built on a small piece of perforated board. Parts layout is not critical. However, all leads should be kept as short as possible and the oscillator and input tank coils should be mounted at right angles to each other. The completed assembly is mounted in a small open backed metal box to minimize the effects of hand capacitance. Tuning is accomplished by drilling a ¼" hole through the box in line with the adjustment screw on the oscillator tuning capacitor. A small piece of 1/8" wooden doweling is then cemented to the tuning screw with a drop of Eastman 910 (or equivalent) cement.

A small dual gang variable capacitor could be used but would be more expensive. Tuning of the input tank circuit is very broad and does not require adjustment after it has been initially set. A hole could be drilled in line with C-2 to permit peaking, using an insulated screwdriver, after the unit is packaged. A BNC connector or RCA type female phonograph connector is mounted at the top of the box for connecting the antenna. Good reception on local signals was obtained with a piece of #14 wire 19" long for the antenna.

Coils L-2 and L-4 can be 100 microhenry VHF rf chokes, or if you don't have any in your junk box you can use TV peaking coils or simply scramble wind about 20" of fine wire on a 100k ¼ Watt resistor.

The completed converter is fastened to the back of the radio using vinyl tape or rubber bands. Placement is not critical, but try to locate coil L-3 as close to the ferrite loop as possible. I have had satisfactory results with the converter lying on the workbench a couple of inches from the radio! Connect the battery and turn the converter on. Tune the radio until a loud hissing sound is heard. Typically this will occur at at least two spots on the dial. Tune the receiver to the loudest hiss. Turn the converter power off to be sure that you are tuned to the output of the converter. Next tune in a signal with C-7 and peak C-2 for maximum signal strength.

Tuning is best done with C-7, although a certain amount of peaking can be done with the transistor radio tuning. As with most regenerative type devices, a high level signal can readily capture the tuning. Although the converter has limitations, I have had excellent reception from aircraft over 200 miles away, and from ground stations up to 30 miles away. ■

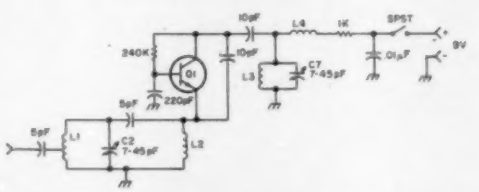
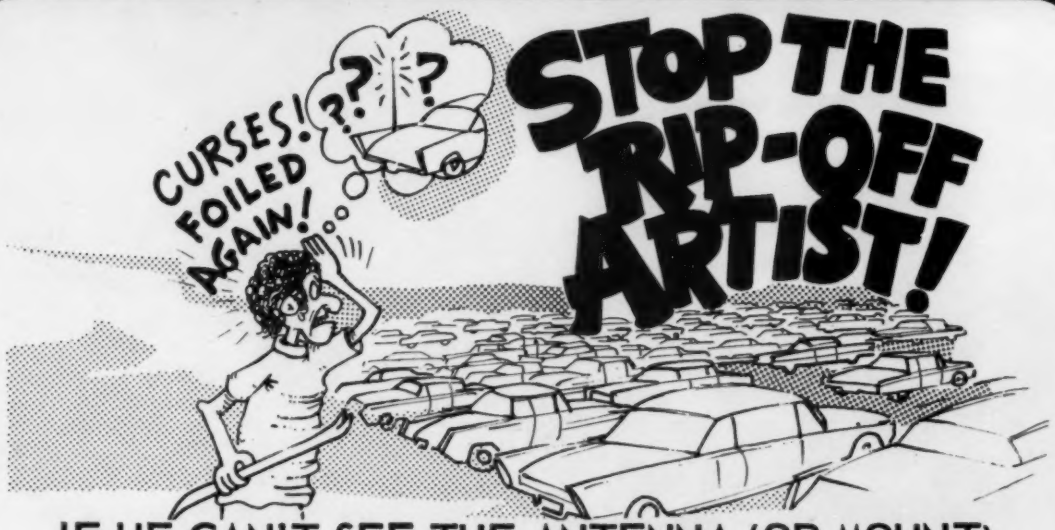


Fig. 1. Schematic of low cost VHF monitor. L-1: 4 turns #22 wire on ¼" diameter form. Center tapped. L-2, L-4: See text. L-3: 4 turns #22 wire on ¼" diameter form. Q-1: NPN VHF transistor 2N2222 or equivalent.



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- Fits virtually all cars and trunk-lip mounts.
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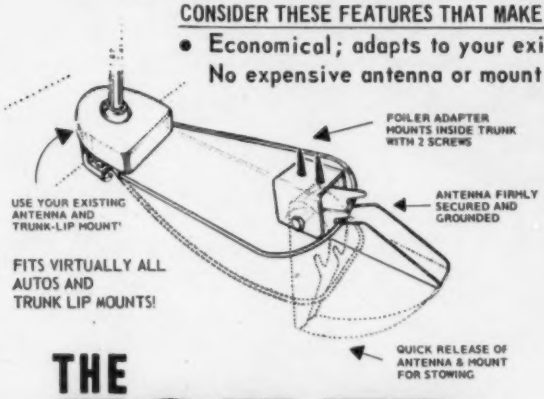
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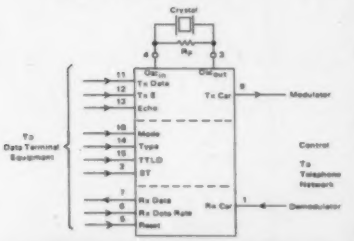

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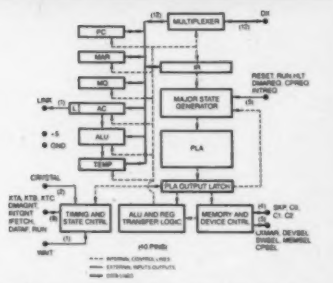

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FCC

from page 155

termination of operation of SHORAN radiolocation systems in the 220-310 MHz range as of October 1, 1971. NMI indicated that it had developed a "second generation" SHORAN-type radiolocation system called HIRAN, which would operate in the 420-450 MHz band allocated in Region 2 to the radiolocation service preimarily and to the amateur service on a secondary basis. This band was selected by NMI because of its suitability for highly accurate medium to long range over-the-horizon radiolocation service required for mineral exploration along the outer continental shelf. NMI contended that higher radiolocation bands, such as 2900-3700 MHz, do not lend themselves to this kind of use because of their limited propagation, and sophisticated radio equipment used in SHORAN-type radiolocation systems has not been developed for operation at these higher frequencies.

3. Prior to issuance of the Commission's Notice, the US Government users who have primary status in the proposed band conducted interference tests using the HIRAN-type equipment. Based on those tests, the IRAC (Interdepartment Radio Advisory Committee) agreed to permit the proposed operation on a secondary basis to Government radiolocation services.

4. In addition, because of an urgent need for radiolocation support of oil exploration operations in Alaska, a waiver was issued on May 23, 1973, to permit non-Government radiolocation in the 420-450 MHz band in that area pending completion of the instant rulemeking proceeding. This waiver was granted on the condition that no harmful interference be caused to the Amateur Radio service, which operates in this band on a secondary basis to Government radiolocation.

5. The proposal embodied in the Commission's Notice contained restrictions similar to those stated in the waiver. The Notice stated that non-Government radiolocation systems would be permitted to operate in the contiguous 48 states and Alaska on a non-interference basis to both Government and amateur stations. Although the Commission felt there was little probability of interference from the proposed non-Government radiolocation systems, the burden would be with the operators of those systems to take corrective measures if interference did occur. Also, as proposed in the Notice, this allocation would be temporary, with a cut-off date of January 1, 1978.

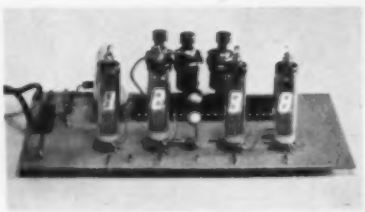
6. Comments were submitted by Offshore Navigation, Inc. (ONI), American Radio Relay League (ARRL), and various amateur radio operators. Reply comments were submitted by ONI. Late comments were also submitted by Texas Instruments, Inc. (TI).

7. ONI is interested in this proceeding as a corporation rendering commercial radiodetermination services on a worldwide basis and as an entity performing research and development on the refinement of the SHORAN/HIRAN type radiolocation system. In its comments, ONI noted that the terms "SHORAN" and "HIRAN" were both used in the Notice and suggested, since HIRAN is simply a term used to identify second-generation SHORAN, that "pulse-ranging" or "SHORAN-type radiolocation systems" be the terms used in the regulations. It also commented that its experience with its HIRAN system operating on waiver in Alaska had been "most favorable." It reiterated the urgent need for radiolocation service of this type because of worldwide fuel shortages and the concomitant need for oil exploration and drilling farther and farther offshore. This need is further heightened, according to ONI, because no other radiolocation system provides the range and accuracy required for long range offshore exploration.

8. ONI's main objection concerned the proposed cut-off date for radiolocation operation in the band. According to ONI, the 2900-3700 MHz band is not a practical substitute for the 420-450 MHz band because of propagation difficulties and the consequent lack of suitable equipment. Furthermore, ONI could see no practical need for a cut-off date, as the probability of harmful interference from the radiolocation service would be very slight, and responsibility for correcting interference, should any occur, would rest with the radiolocation licensee.

9. ARRL, reflecting the views of the amateurs who filed comments in this proceeding, opposed the Commission's proposals. It pointed out the increased amateur occupancy in the 420-450 MHz band, as well as special amateur operations (for example the Oscar 7 satellite) in certain segments of the band which it felt should be protected. It stated that existing Government radiolocation operations in the band had interfered with amateurs, and that there would be a problem identifying the source of interference from non-Government radiolocation systems because of their use of pulse-type emissions. It was skeptical about the likelihood of adherence to any cut-off date once the proposed service is established in the band.

10. Various radio amateurs submitted comments, all of which objected to the proposed allocation, mainly because of



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alleged problems of potential interference and the difficulty in identifying radiolocation operations which might be interfering in a particular area. The primary concern was interference to amateur repeater operations which they felt might have to be shut down because of interference from the radiolocation service. Several amateur operators offered suggestions to help alleviate the identification problem. One suggested that local HIRAN operations be posted at FCC field offices. Another recommended that radiolocation users be required to co-ordinate their operations with amateur frequency co-ordinators for the areas in which the radiolocation system will be used. An Amateur Radio Club in California offered to provide the facilities so an interference study could be conducted over the California coast.

11. In its reply comments, ONI stated that except for a general and unquantified reference by the ARRL, not one Amateur complained of interference from Government radiolocation stations. Furthermore, ONI cited several reasons why interference would be highly unlikely. It stated that there are thousands of miles of coastline and very limited Amateur usage of this band. Also it said that it would co-ordinate its transmitter site locations with appropriate Amateur organizations to avoid use of the channel employed by the Oscar 7 satellite. It indicated that it is also working toward minimizing the SHORAN power and bandwidth requirement.

12. TI's late comments supported the concept embodied in the rulemaking and the proposed rule change. TI explained that it too has developed a radiolocation system which would utilize the 420-450 MHz band in connection with geophysical exploration services offered to the oil companies. It echoed ONI's position that developing domestic petroleum resources has become an increasingly urgent matter and that the offshore area of the US offers a great untapped source. As a part of its development of this service, TI indicated that it has operated experimental radiolocation systems in several areas of the U.S. within the subject band. Its system in the Gulf Coast area of Texas has been in operation for 2 years at 430 MHz, and a more recent operation began this July in the Northeast area of the U.S., centered at 429 MHz. No harmful interference has been reported as a result of these operations.

13. The Commission is well aware of the urgency associated with this country's energy development program, in which offshore exploration plays a major role. The radiolocation services proposed by ONI and TI would appear to provide a very useful, if not essential, tool in that exploration effort. No satisfactory alternatives to either the service or frequency band proposed appear feasible within the immediately foreseeable future. Therefore, we are persuaded that some accommodation should be made for non-Government radiolocation service in the 420-450 MHz band, notwithstanding the objections raised by the radio amateurs.

14. Moreover, we believe that much of the concern expressed by the amateurs is largely without basis. There was nothing substantive in any of the comments to challenge our view, as stated in the Notice, that there would be little potential interference to amateurs from the proposed service. We still believe this to be true and further believe that making the non-Government radiolocation service secondary with regard to amateurs will provide sufficient administrative control over any interference which might occur. Any additional limitations or coordination requirements would be redundant, needlessly burdening the radiolocation service and reducing its effectiveness while providing little or no additional protection to the amateurs.

15. In addressing the comments made by the amateurs voicing their concern over potential interference from HIRAN and the consequent problem of identification, we feel that no such problem should arise because of the licensing procedure as well as the nature of the system itself. The basic HIRAN system consists of fixed units with some mobile units. The authorization is issued by the Commission for the fixed unit at a specific location, and any time the unit moves, a modified authorization must be issued. Therefore, complete data on each system will be on file at the Commission and will be accessible to any interested parties. Further, there will in all probability be a small number of licensees using these frequencies. The operation itself is of a highly controlled nature and handled by experienced operators.

16. Consequently, we are adopting the proposed allocation and rules essentially as set forth in the Notice. There are only two changes: (1) the term "pulse-ranging" is being substituted for the term "HIRAN" as suggested by ONI; and (2) the proposed "cutoff" date of January 1, 1978, for non-Government radiolocation systems in the band is being replaced by the date of January 1, 1981. We make this latter change because based on the information available tous we believe use of the 2900-3700 MHz band poses difficult technical problems for this type of application and would not offer a practical alternative to the 420-450 MHz band for at least the next five years. Also, although various satellite radiolocation systems are being developed which might eventually be used for offshore exploration purposes, we do not realistically foresee them becoming available for regular non-Government use in offshore areas prior to 1981.

17. Accordingly, pursuant to authority contained in Sections 4(i) and 303(r) of the Communications Act of 1934, as amended,

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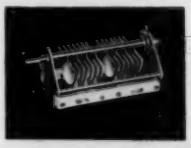

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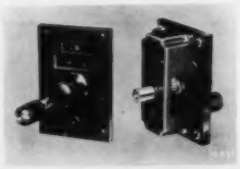

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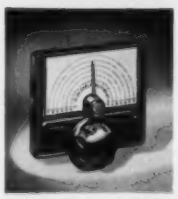

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IT IS ORDERED that effective April 22, 1976, Parts 2 and 91 of the Commission's Rules are AMENDED as shown in the attached Appendix and that this proceeding is hereby terminated.

FEDERAL COMMUNICATIONS COMMISSION
Vincent J. Mullins, Secretary

NOTE: Rules changes herein will be covered by T.S. II(72)-9 and T.S. V(74)-3.

APPENDIX

1. In §2.106, columns 5 through 11 for the band 420-450 MHz are amended, footnote US35 is modified, and footnote US217 is added to read as follows:

§2.106 Table of Frequency Allocations

Band (MHz)	Allocation	Services	Class of Station	Frequency (MHz)	Nature OF SERVICES of stations
5	6	8	9	10	11
420-450	G, NG. (US 217) (US 87) (US 7) (320A) (US 35)	Amateur Amateur-Satellite	Amateur. Earth. Space.		AMATEUR. AMATEUR-SATELLITE.

US35: Except as provided for by footnotes 320A, US87, and US217, the only non-Government services permitted in the band 420-450 MHz are the amateur service and the amateur satellite service. The amateur services shall not cause harmful interference to the Government radiolocation service.

* * * * *

US217: Pulse-ranging radiolocation systems may be authorized for Government and non-Government use in the 420-450 MHz band along the shorelines of Alaska and the contiguous 48 states. Such authorizations will be granted on a case-by-case basis, and all stations operating in accordance with those authorizations will be secondary to stations operating in accordance with the allocation table. Stations authorized pursuant to this footnote must cease operation on or before January 1, 1981. All power and antenna height specifications shall be made on a case-by-case basis.

* * * * *

2. In §91.604(a) the frequency table is amended and paragraph (b)(20) is added to read as follows:

§91.604 Frequencies available

(a) Frequency or band	Class of Station(s)	Limitation(s)
* * *	* * *	* * *
310	do	2
420-450	do	10
2450-2500	do	3
* * *	* * *	* * *

(b)(20) Non-Government pulse-ranging radiolocation stations in this band are secondary to the Government Radiolocation Service, the Amateur Radio Service and the Amateur Satellite Service. Stations authorized pursuant to this footnote must cease operation on or before January 1, 1981. All power and antenna height specifications shall be made on a case-by-case basis.

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7●. S.B.E.
8●. Standard 146/826
9●. Standard Horizon
10●. Clegg HT-146

The first two numbers of the frequency are deleted for the sake of being non-repetitive. Example: 146.67 receive would be listed as – 6.67R

1. 6.01T	9. 6.13T	17. 6.19T	25. 6.31T	33. 6.52T	41. 7.03R	49. 7.15R	57. 7.27R	
2. 6.61R	10. 6.73R	18. 6.79R	26. 6.91R	34. 6.52R	42. 7.66T	50. 7.78T	58. 7.90T	
3. 6.04T	11. 6.145T	19. 6.22T	27. 6.34T	35. 6.55T	43. 7.06R	51. 7.18R	59. 7.30R	
4. 6.64R	12. 6.745R	20. 6.82R	28. 6.94R	36. 6.55R	44. 7.69T	52. 7.81T	60. 7.93T	
5. 6.07T	13. 6.16T	21. 6.25T	29. 6.37T	37. 6.94T	45. 7.09R	53. 7.21R	61. 7.33R	
6. 6.67R	14. 6.76R	22. 6.85R	30. 6.97R	38. 7.60T	46. 7.72T	54. 7.84T	62. 7.96T	
7. 6.10T	15. 6.175T	23. 6.28T	31. 6.40T	39. 7.00R	47. 7.12R	55. 7.24R	63. 7.36R	
8. 6.70R	16. 6.775R	24. 6.88R	32. 6.46T	40. 7.63T	48. 7.75T	56. 7.87T	64. 7.99T	
							65. 7.39R	

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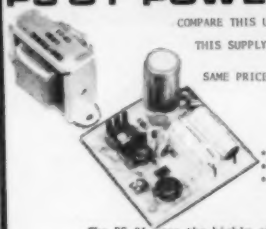

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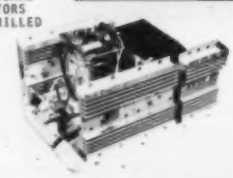

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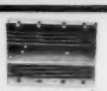
Impedance	:	330 Ohms

The bandwidth can be narrowed by loading filter with a higher impedance



FACTORY NEW!!!

nude

DRILLED FOR 4 TO-3 TRANSISTORS
12" LONG APPROX. 120WATTS $3.50

DRILLED FOR 2 TO-3 TRANSISTORS
6" LONG APPROX 60WATTS $1.80

CURRENT LIMIT RESISTORS

HARD TO FIND VALUES:

.1 OHM @ 10W
.032 OHM @ 10W 3/$1
2 OHM @ 10W

WOULD YOU BELIEVE-

50 OHMS @ 100WATTS ?!

Whats?

FOUR OF OUR CERAMIC, NON-INDUCTIVE RESISTORS WILL DISSIPATE THAT MUCH WHEN CONNECTED IN SERIES/PARALLEL AND MOUNTED IN A GOOD HEATSINK.

4/99¢

We can't think of a thing to do with these.... so you can have them cheap

Everybody we told about this kit said it was "too cheap — you should sell it for more" . . . but we think the buyer can recognize a super deal SO HERE IT IS!!

Capacitor Discharge Ignition KIT

$9.95

Double the output of your cars' ignition system

CONTAINS:

- PC BOARD
- SPECIAL TOROID TRANSFORMER
- 2 100W Power Transistors
- 8A SCR
- 4 800 Volt Diodes
- All resistors & caps
- COMPLETE INSTRUCTIONS

CASES ARE AVAILABLE!

$5.95 includes Heatsink & Hardware

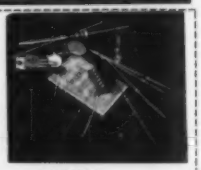
Does not need a special coil

Easy to install

2N2222 Unmarked but tested good!

12/$1

TO 18



LOUD!

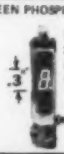
10 WATT WARBLE ALARM KIT

All the components you need to build a dual tone warble alarm but the speaker.

Complete with PC Board

6-15VDC $2.50 complete

GREEN PHOSPHOR READOUT



1.4 V Filament
24 V segment
Low Current
(40 mA per readout)

.3

DG8F
75¢ each
(works on 12volts)
10 for $7.00

1101 MEMORIES

RAM

256 X 1

$1.25 LIMITED QUANTITY

FOR THE HARD-CORE EXPERIMENTER:

MM5375/AB ALARM CLOCK CHIPS 3.75

- Pre-settable 24Hr Alarm
- Snooze Circuit
- Adjustable Brightness
- AM/PM Indicator
- Reset
- Power Failure Warning
- Beeper tone Alarm output

IF YOU HAVE A FEW TRANSISTORS AND RESISTORS LAYING AROUND YOU CAN SAVE $$$$

We furnish a complete instruction manual complete with full size PC Board Layouts for either Common Cathode or Common Anode operation

DRILLED AND PLATED PC BOARD WITH PARTS LAYOUT: Mounts the Clock Chip, Transistors, Caps and resistors. You build the Readout Board 1.75

specify readout polarity

ORDERS OVER $50 TAKE 10% DISC

SEND 25¢ FOR COMPLETE CATALOG....FREE WITH AN ORDER

7400N TTL

SN7400N*	.13	SN7453N	.27	SN74150N	1.00
SN7401N	.16	SN7454N	.20	SN74151N	.70
SN7402N	.21	SN7458A	.25	SN74153N	.89
SN7403N	.16	SN7460N	.22	SN74154N*	1.25
SN7404N*	.16	SN7470N	.49	SN74155N	.99
SN7405N	.24	SN7471N*	.69	SN74156N	.99
SN7408N	.20	SN7472N	.39	SN74157N	.99
SN7407N	.29	SN7473N*	.37	SN74160N	1.25
SN7408N	.25	SN7474N*	.32	SN74161N	.99
SN7409N	.26	SN7475N*	.56	SN74163N*	.99
SN7410N*	.16	SN7476N*	.32	SN74164N	1.10
SN7411N	.39	SN7478N*	5.00	SN74165N	1.10
SN7413N	.59	SN7480N	.50	SN74166N	1.25
SN7414N	.45	SN7482N	.98	SN74167N	5.50
SN7416N	.70	SN7483N	.70	SN74170N	2.10
SN7416N	.35	SN7485N	.89	SN74172N	18.00
SN7417N	.35	SN7486N	.39	SN74173N	1.50
SN7420N	.71	SN7488N	3.50	SN74174N	1.25
SN7421N	.33	SN7489N	2.25	SN74175N	.99
SN7422N*	.49	SN7490N*	.45	SN74176N	.90
SN7423N	.37	SN7491N	.75	SN74177N	.90
SN7425N	.29	SN7492N	.49	SN74180N	.99
SN7426N	.29	SN7493N*	.49	SN74181N	2.49
SN7427N	.37	SN7494N	.79	SN74182N	.95
SN7429N	.42	SN7495N	.70	SN74184N	1.95
SN7430N	.26	SN7496N	.89	SN74185N	2.20
SN7432N	.31	SN7497N*	4.89	SN74186N*	5.00
SN7437N	.27	SN74100N*	1.00	SN74187N	6.00
SN7438N	.27	SN74107N	.39	SN74190N	1.10
SN7439N	.35	SN74121N*	.39	SN74191N	1.25
SN7440N	.15	SN74122N*	.39	SN74192N*	.89
SN7441N	.89	SN74123N*	.70	SN74193N*	.89
SN7442N	.59	SN74125N	.60	SN74194N	1.25
SN7443N	.75	SN74126N	.60	SN74195N	.75
SN7444N	.75	SN74132N	1.00	SN74196N	1.25
SN7445N	.75	SN74136N	.95	SN74197N	.75
SN7446N	.81	SN74148N	1.15	SN74198N	1.75
SN7447N*	.69	SN74149N*	4.00	SN74199N	1.75
SN7448N	.79	SN74143N*	4.50	SN74200N	5.50
SN7450N	.26	SN74144N*	4.50	SN74279N*	.90
SN7451N	.27	SN74145N	1.15	SN74251N	1.79
SN7452N*	.27	SN74147N	2.35	SN74284N	6.00
		SN74148N	2.00	SN74285N	6.00

MANY OTHERS AVAILABLE OR REQUEST
20% Discount for 100 Combined 7400's

CMOS

CD4000	.25	CD4035	1.85	74C00N	.75
CD4001	.25	CD4040	2.45	74C20N	.65
CD4002	.25	CD4042	1.90	74C30N	.65
CD4006	2.89	CD4043	2.45	74C42N	2.15
CD4007	.25	CD4044	1.50	74C73N	1.50
CD4008	.59	CD4046	2.51	74C74	1.15
CD4010	.39	CD4047	2.75	74C90N	3.00
CD4011	.25	CD4049	.79	74C93N	2.00
CD4012	.25	CD4050	.79	74C95N	2.00
CD4013	.47	CD4051	2.95	74C107N	1.25
CD4015	.56	CD4052	2.95	74C151	2.90
CD4016	.39	CD4053	2.95	74C154	3.00
CD4017	1.35	CD4060	3.25	74C157	2.15
CD4019	.55	CD4066	1.75	74C160	3.25
CD4020	1.49	CD4068	.45	74C161	3.25
CD4022	1.25	CD4069	.45	74C163	3.00
CD4023	.25	CD4071	.45	74C164	3.25
CD4024	1.50	CD4072*	.45	74C174	2.65
CD4025	.25	CD4081	.45	74C173	2.60
CD4027	.69	CD4511	2.55	74C193	2.75
CD4029	1.65	CD4518	2.50	74C195	2.75
CD4029	2.98	74C00N	.39	MC4044*	4.50
CD4030	.65	74C02N	.55	MC14519*	.56

LINEAR

LM300H	.89	LM377N	4.00	LM1351N	1.65
LM301H	.35	LM380N	1.39	LM1414N	1.75
LM301CN	.35	LM380CN	1.05	LM1458C	.65
LM302H	.75	LM381N	1.79	LM1496N	.95
LM304H	1.00	LM382N	1.79	LM2901N	2.95
LM305H	.95	LM383N	1.79	LM3065N	.69
LM307CN	.35	LM384N	1.79	LM3900N	.55
LM308H	1.00	NE501K	6.00	LM3905N	.60
LM308CN	1.00	NE510A	6.00	LM3909*	1.25
LM309H	1.10	NE531H	3.00	LM3909N*	1.25
LM309K	1.25	NE536T	6.00	LM555N	1.85
LM310CN	1.15	NE540L	6.00	LM555BN	1.85
LM311H	.90	NE550N	.79	MC5558V	1.00
LM311N	.90	NE553	2.50	LM7525N	.90
LM318CN	1.50	NE555V*	.45	LM7535N	1.25
LM319N	1.30	NE5080*	5.00	8038N*	4.95
LM319D	9.00	NE5618*	5.00	LM75450	.49
LM320K-5	1.35	NE5628*	5.00	75451CN	.39
LM320K-5.2	1.35	NE565H*	.99	75452CN	.39
LM320K-12	1.35	NE565N*	1.25	75453CN	.39
LM320K-15	1.35	NE566CN*	1.85	75454CN	.39
LM320T-5*	1.75	NE567H*	1.25	75491CN	.79
LM320T-6*	1.75	NE567V*	1.50	75492CN	.89
LM320T-12*	1.75	LM703CN	.45	75494CN	.89
LM320T-18*	1.75	LM709H	.29	**RCA LINEAR**	
LM323K-5*	9.90	LM709N	.29	CA3013	1.70
LM324N	1.80	LM710N	.79	CA3023	2.15
LM339N	1.70	LM711N	.39	CA3035	2.25
LM340K-5	1.95	LM723N	.55	CA3036	1.35
LM340K-12	1.95	LM723H	.55	CA3046	1.15
LM340K-15	1.95	LM733N	1.00	CA3059	2.46
LM340K-24	1.95	LM739N	1.29	CA3060	2.80
LM340T-5	1.75	LM741CH	.35	CA3080	.85
LM340T-6	1.75	LM741CN	.35	CA3081	1.75
LM340T-8*	1.75	LM741 14N	.39	CA3082	2.00
LM340T-18*	1.75	LM747H	.79	CA3083	1.60
LM340T-12	1.75	LM747N	.79	CA3086	.59
LM340T-15	1.75	LM748H	.39	CA3089	3.25
LM340T-24	1.75	LM748N	.39	CA3091	8.25
LM350N	1.00	LM1303N	.80	CA3123	1.85
LM351CN	.65	LM1304N	1.10	CA3130*	1.49
LM370N	1.15	LM1305N	1.40	CA3600	1.75
LM370H	1.15	LM1307N	.85	RC4194	5.95
LM373N	3.25	LM1310N	2.95	RC4195	3.25

KITS EXAR ICS

XR-2206KA — **SPECIAL $17.95**
Includes monolithic function generator IC, PC board, and assembly instruction manual

XR-2206KB — **SPECIAL $27.95**
Same as XR 2206KA above and includes external components for PC board.

TIMERS		**STEREO DECODERS**	
XR-555CP	0.89	XR-1310P	$3.20
XR-320P	1.55	XR-1310EP	3.20
XR-558CP	1.85	XR1800P	3.20
XR-2556CP	3.20		
XR-2240CP	3.25	**WAVEFORM GENERATORS**	
		XR-205	8.40
PHASE LOCKED LOOPS		XR-2206CP	4.40
XR-210	5.20	XR-2207CP	3.85
XR-215	6.00	**MISCELLANEOUS**	
XR-567CP	1.95	XR-2211CP	6.70
XR-2567CP	2.99	XR-2261	3.70
		XR4136	2.00

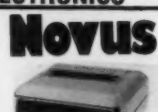
DATA HANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	**$2.95**
CMOS	Pin-out & Description of 4000 Series ICS	**$2.95**
LINEAR	Pin-out & Functional Description	**$2.95**
	ALL THREE HANDBOOKS $8.95	

CONSUMER ELECTRONICS

DIGITAL WATCH
This watch is manufactured by National Semiconductor. It provides 5 functions; hours, minutes, seconds, date, A.M. indicator dot. Accuracy is assured to 5 seconds per month by precision quartz crystal. If something should go wrong with the watch, repair is assured within 48 hours after it is received. Complete with steel black leather band.

ES4-YS
3 MICRON GOLD PLATE BEZEL
$29.95
NOT A KIT



DIGITAL ALARM CLOCK
This 4 digit Novus Alarm Clock is a very reliable and smartly styled unit. It provides such features as an alarm settable to any minute of the day, a 7 minutes snooze alarm, a power failure indicator, and even an A.M., P.M. indicator.

NOT A KIT **$19.95**

OPTO ELECTRONICS

XCITON
LITRONIX
MONSANTO

DISCRETE LEDS

R - RED
G - GREEN
Y - YELLOW
O - ORANGE

125" dia.

XC208R	5/$1
XC208G	4/$1
XC208Y	4/$1
XC208O	4/$1

.185" dia.

XCS26R	5/$1
XCS26G	4/$1
XCS26Y	4/$1
XCS26O	4/$1

.190" dia.

XC111R	5/$1
XC111G	4/$1
XC111Y	4/$1
XC111O	4/$1

.200" dia.

XC22R	5/$1
XC22G	4/$1
XC22Y	4/$1
XC220	4/$1

.200" dia.

XCS58R	5/$1
XCS58G	4/$1
XCS58Y	4/$1
XCS58O	4/$1

.085" dia.

MV50	
.085" dia. fstcro	
red led	
	6/$1

DISPLAY LEDS

TYPE	POLARITY	HT		TYPE	POLARITY	HT	
MAN 1	COMMON ANODE	.270	$3.25	MAN 74	COMMON CATHODE	.300	$1.50
MAN 2	5 x 7 DOT MATRIX	.300	4.95	DL707	COMMON ANODE	.300	$1.50
MAN 3	COMMON CATHODE	.125	.39	DL747	COMMON ANODE	.600	2.25
MAN 4	COMMON CATHODE	.187	1.95	DL750	COMMON CATHODE	.600	2.49
MAN 7	COMMON ANODE	.300	1.50	DL33B	COMMON CATHODE	.110	1.25
MAN 7G	COMMON ANODE-GREEN	.300	2.50	FND70	COMMON CATHODE	.250	.50
MAN 7Y	COMMON ANODE-YELLOW	.300	2.50	FND503	COMMON CATHODE	.500	1.75
MAN 72	COMMON ANODE	.300	1.50	FND507	COMMON ANODE	.500	1.75

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin	$.17	.16	.15
14 pin	.20	.19	.18
16 pin	.22	.21	.20
18 pin	.29	.28	.27
22 pin	.37	.36	.35

	1-24	25-49	50-100
24 pin	$.38	.37	.36
28 pin	.45	.44	.43
36 pin	.60	.59	.58
40 pin	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin	$.27	.25	.24
16 pin	.30	.27	.25
18 pin	.35	.32	.30
24 pin	.49	.45	.42

	1-24	25-49	50-100
28 pin	$. 59	.99	.81
36 pin	1.39	1.25	1.15
40 pin	1.59	1.45	1.30

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100
8 pin	$.30	.27	.24
14 pin	.35	.32	.29
16 pin	.38	.35	.32

	1-24	25-49	50-100
24 pin	$. 70	.63	.57
28 pin	1.10	1.00	.90
36 pin	1.75	1.40	1.26
40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
10 pin	$.45	.41	.37
14 pin	.50	.38	.37
16 pin	.43	.42	.41
18 pin	.75	.68	.62

	1-24	25-49	50-100
24 pin	$1.05	.95	.85
28 pin	1.40	1.25	1.10
36 pin	1.58	1.45	1.30
40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM	12 OHM	15 OHM	18 OHM	22 OHM		
		27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5% - 50 PCS.	
ASST. 2	5 ea.	68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	1/4 WATT 5% - 50 PCS.	
		180 OHM	220 OHM	270 OHM	330 OHM	390 OHM		
ASST. 3	5 ea.	470 OHM	560 OHM	680 OHM	820 OHM	1K	1/4 WATT 5% - 50 PCS.	
		1.2K	1.5K	1.8K	2.2K	2.7K		
ASST. 4	5 ea.	3.3K	3.9K	4.7K	5.6K	6.8K	1/4 WATT 5% - 50 PCS.	
		8.2K	10K	12K	15K	18K		
ASST. 5	5 ea.	22K	27K	33K	39K	47K	1/4 WATT 5% - 50 PCS.	
		56K	68K	82K	100K	120K		
ASST. 6	5 ea.	150K	180K	220K	270K	330K	1/4 WATT 5% - 50 PCS.	
		390K	470K	560K	680K	820K		
ASST. 7	5 ea.	1M	1.2M	1.5M	1.8M	2.2M	1/4 WATT 5% - 50 PCS.	
		2.7M	3.3M	3.9M	4.7M	5.6M		

ALL OTHER RESISTORS FROM 2.2 OHMS 5.6M AVAILABLE IN MULTIPLES OF 5 ea.
5-25 PCS. .05 ea. 30-95 PCS. .04 ea. 100-495 PCS. .03 ea. 500-995 .027 ea.

14 PCS. POTENTIOMETER ASSORTMENTS

ASST. A 2 ea. 10 OHM-20 OHM-50 OHM-100 OHM-200 OHM-250 OHM-500 OHM
ASST. B 2 ea. 1K, 2K, 2.5K, 10K, 20K, 25K, 50K
ASST. C 2 ea. 50K, 100K, 200K, 250K, 500K, 1M, 2M

$9.95 Per Asst.

Each assortment contains 14 pcs of 10 turn pots. All pots are available in single unit quantities. **$.69 ea.**

Astrisk Denotes Items On Special For This Month
Satisfaction Guaranteed. $5.00 Min. Order. U.S. Funds.
California Residents — Add 6% Sales Tax — Data Sheets 25c each
Send a 13c Stamp (postage) for a FREE 1976 Catalog

JAMES

1021 HOWARD ST., SAN CARLOS, CA. 94070
PHONE ORDERS — (415) 592-8097

74LS00 TTL

74LS00	.39	74LS85	.89	74LS151	1.89
74LS02	.39	74LS73	.65	74LS153	1.89
74LS03	.39	74LS74	.65	74LS157	1.95
74LS04	.45	74LS75	.79	74LS160	2.25
74LS05	.45	74LS76	.65	74LS163	2.25
74LS08	.39	74LS83	2.19	74LS164	2.25
74LS10	.39	74LS86	.89	74LS181	3.69
74LS13	.79	74LS90	1.25	74LS190	2.85
74LS14	2.19	74LS92	1.25	74LS191	2.85
74LS20	.39	74LS93	1.25	74LS192	2.85
74LS26	.49	74LS95	2.19	74LS193	2.85
74LS27	.45	74LS96	1.89	74LS194	2.25
74LS28	.49	74LS107	.65	74LS195	2.25
74LS30	.39	74LS112	.65	74LS257	1.89
74LS32	.45	74LS132	1.55	74LS280	.50
74LS40	.49	74LS136	.65	74LS279	.79
74LS51	.39	74LS138	1.89	74LS670	5.95

DL728
The DL728 is a dual 0.5" common cathode red display. It is ideal for use with clock chips, as segments are already multiplexed. **$2.95**

DPDT			AMT	1	2-9	10-24	25-49
	ON	OFF	ON	221	3.05	2.85	1.07
	ON	NONE	ON	222	2.99	2.39	1.69
	ON	OFF	ON	121	2.35	1.95	1.43
	ON	NONE	ON	122	3.05	1.85	1.21

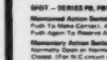
MINATURE TOGGLE

DPDT — SERIES PB, PBT	Model Number	1 Each	Quantity and prices 2-9	10-24	25-49
Momentary Action Switch: Push To Make Contact. And, Push Again To Reserve Action	PB-123	$2.35	$1.95	$1.47	$1.30
Momentary Action Switch: Normally Open or Normally Closed. (For N.C.+N.O. add terminals 2 & 1, for N. O. 2 & 3, for N. C and N. O., 1, 2 & 3)	PB-126	$2.35	$1.95	$1.47	$1.30

PUSH BUTTON

5 AMP RATINGS

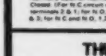
THUMBWHEEL SWITCHES



Thumbwheel Switch Only
SP - Front Mount
DP - Rear Mounting

Part No.	Description	Price
SP-10	Single Pole 10 Position	$2.50
SP-12	Decimal	3.00
SP-21	1/0 Position BCD only	7.50
SP-31	"	3.00

Ordering: Order desired switch or switches and add necessary components for your particular application.



ACCESSORIES		
Part No.	Description	Price
SR DP	End Plate (Pair)	$1.50
SR DP	Divider Plate (each)	.40
SR BB	Barrel Body (each)	.40
SR HB	Half Body (each)	.40

ACCESSORIES		
Part No.	Description	Price
SR DP	End Plate (pair)	$.50
SR DP	Divider Plate (each)	.40
SR BB	Barrel Body (each)	.40
SR HB	Half Body (each)	.40

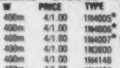
8 POSITION ROTARY SWITCH — **$7.9**

These switches are a 7 position, one position open, rotary switch enclosed in a TO-5 can. They have a standard 8 pin configuration and will mount perfectly on printed circuit board

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005*	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006*	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007*	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N8658	15	400m	4/1.00	1N4154	35	10m	12/1.00
1N5232	5.6	500m	2/$	1N4734	5.6	1w	2/$
1N5234	6.2	500m	2/$	1N4735	6.2	1w	2/$
1N5235	6.8	500m	2/$	1N4736	6.8	1w	2/$
1N5236	7.5	500m	2/$	1N4738	8.2	1w	2/$
1N456	25	40m	5/1.00	1N4742	12	1w	2/$
1N458	150	7m	6/1.00	1N4744	15	1w	2/$
1N459A	180	10m	5/1.00	1N1183	50 PIV	35 AMP	1.00
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4003	200 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00
1N4004	400 PIV	1 AMP	12/1.00				

TRANSISTORS



MPS A05	5/$1.00	PN3567	3/$1.00	PN4249	4/$1.00
MPS A06	5/$1.00	PN3568	4/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN3569	4/$1.00	2N4401	4/$1.00
2N2221	4/$1.00	PN3569	4/$1.00	2N4402	4/$1.00
2N2222A	5/$1.00	2N3704	5/$1.00	2N4403	4/$1.00
2N2369	5/$1.00	2N3705	5/$1.00	2N4409	5/$1.00
2N2369A	4/$1.00	2N3706	5/$1.00	2N4410	4/$1.00
PN2410	5/$1.00	2N3707	5/$1.00	2N5087	4/$1.00
2N2484	4/$1.00	2N3711	5/$1.00	2N5088	4/$1.00
2N2894	4/$1.00	2N3724	$. 65	2N5089	4/$1.00
2N2907A	5/$1.00	2N3725	$1.00	2N5129	5/$1.00
2N2925	5/$1.00	2N3903	5/$1.00	2N5138	5/$1.00
2N2926	5/$1.00	2N3904	4/$1.00	2N5139	5/$1.00
2N3053	$. 60	2N3906	4/$1.00	2N5209	5/$1.00
MJE3055	$1.00	2N3866	4/$1.00	2N5551	5/$1.00
MJE2955	$1.25	2N4013	3/$1.00	2N5551	5/$1.00
2N3302	5/$1.00	2N4014	3/$1.00	C106B1SCR	2/$1.00
2N3398	5/$1.00	2N4124	5/$1.00	2N5432	$2.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
1pf	.05	.04	.03	001μF	.05	.04	.035
2pf	.05	.04	.03	.0047μF	.05	.04	.035
3pf	.05	.04	.03	.01μF	.05	.04	.035
100 pf	.05	.04	.03	.022μF	.06	.05	.04
220 pf	.05	.04	.03	.047μF	.06	.05	.04
470 pf	.05	.34	.035	1μF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.09
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+ 20% DIPPED TANTALUMS (SOLID) CAPACITORS

1 .35V	.28	.23	.17	1.5 .35V	.36	.26	.21
15 35V	.28	.23	.17	2.2 25V	.31	.27	.22
22 35V	.28	.23	.17	3.3 25V	.31	.27	.22
33 35V	.28	.23	.17	4.7 25V	.32	.26	.23
47 35V	.28	.23	.17	6.8 25V	.38	.31	.25
68 35V	.28	.23	.17	10 25V	.40	.35	.29
1.0 35V	.28	.23	.17	15 25V	.63	.50	.40

MINATURE ALUMINUM ELECTROLYTIC CAPACITORS

	Axial Lead			Radial Lead		
.47 50V	.15	.13	.10	.47 25V	.15	.13	.10
1.0 50V	.16	.14	.11	.47 50V	.16	.14	.11
3.3 50V	.15	.13	.10	1.0 16V	.15	.13	.10
4.7 25V	.16	.14	.11	1.0 25V	.16	.14	.11
10 25V	.15	.13	.10	1.0 50V	.16	.14	.11
10 50V	.16	.14	.12	4.7 16V	.15	.13	.10
22 25V	.17	.15	.12	4.7 25V	.15	.13	.10
22 50V	.24	.20	.18	4.7 50V	.16	.14	.11
47 25V	.19	.17	.15	10 16V	.14	.12	.09
47 50V	.25	.21	.19	10 25V	.15	.13	.10
100 25V	.24	.20	.18	10 50V	.16	.14	.12
100 50V	.35	.30	.28	47 10V	.24	.21	.19
220 25V	.32	.28	.25	100 10V	.19	.15	.14
220 50V	.45	.41	.38	+100 5V	.14	.09	.10
470 25V	.33	.29	.27	100 50V	.15	.30	.26
1000 16V	.56	.50	.45	220 16V	.23	.17	.15
2200 16V	.70	.62	.55	470 25V	.31	.28	.26

6 Digit LED Clock Kit - 12/24 hr.

$9.50 ea. IN QUANTITIES OF 1 TO 5 — **$8.50** ea. IN QUANTITIES OF 6 OR MORE

KIT INCLUDES
- INSTRUCTIONS
- QUALITY COMPONENTS
- MONEY BACK GUARANTEE
- 50 or 60 Hz OPERATION
- 12 or 24 HR OPERATION

6 — LED Readouts (FND-70 .25 in. Red, com. cathode)
1 — MM5314 Clock Chip (24 pin)
13 — Transistors
3 — Switches
3 — Capacitors
5 — Diodes
9 — Resistors
24 — Molex pins for IC socket

ORDER KIT #850
AN INCREDIBLE VALUE!

"Kit #850 will furnish a complete set of clock components as listed. The only additional items required are a 7-11 VAC transformer, a circuit board and a cabinet, if desired."

Printed Circuit Board for kit #850 or #850-4 (etched & drilled fiberglass) $2.95
Standard Transformer 115 VAC/8 VAC. 1.50
Molded Plug Transformer 115 VAC/10 VAC (with cord) 2.50
Plexiglas Cabinet II red chassis, white case (see below) 5.95

KIT #850-4 same as #850 except larger .4" LEDs $11.95

60 Hz Xtal Timebase Kit
Power: 5-16VDC/2.5 mA @ 12 VDC.
Size: PC board approx 1"x1¾".
Accuracy: ±2 ppm (adjustable)
This is a complete — single IC kit with info for easy hookup to most IC clocks.

Will free IC digital clock from ac timebase and allow 12 VDC operation. Use in car, van, boat, camper, etc. **6/28.95, 5.95 each.**
(4.95 when purchased with any clock kit.)

Jumbo Digit Conversion Kit — for LED clocks. Kit provides a multiplex display board and six .5" LED digits (FND-503 or FND-507) LEDs require only 5 mA/seg and can be driven by most any LED clock circuit. Data for displays and hookup included. (Connections from this board will line up point to point with kit #850 PC board) Specify common anode or cathode displays **$9.95**

Jumbo Digit Clock Kit Complete — Kit features six .5" red digits. All components, PC boards, plug transformer, line cord, etc. Uses mm5314 IC, 50/60 Hz op., 12 or 24 hr. (will fit cab. I) Kit #5314-5 complete less case **$19.95**

6 Digit LED Clock-Calendar-Alarm Kit

• 12/24 HR TIME • JUMBO DIGITS (MAN-64) • 28-30-31 DAY CALENDAR • AC FAILURE/BATTERY BACK-UP • 24 HR ALARM — 10 MIN. SNOOZE • ALTERNATES TIME (8 SEC) AND DATE (2 SEC) OR DISPLAYS TIME ONLY AND DATE ON DEMAND • THIS KIT USES THE FANTASTIC CT-7001 CHIP. FOR THE PERSON THAT WANTS A SUPER CLOCK KIT (TOO MANY FEATURES TO LIST)!

50/60 Hz OP

COMPLETE KIT, including Power Supply, Line Cord, Drilled PC Boards, etc. **39.95** ORDER KIT #7001B (CASE NOT INCLUDED)

Kit #7001-C same as #7001-B but has different LEDs. Uses 4 DL-747 .63" digits & 2 MAN-7 .3" digits for seconds. Complete kit, less case. **$42.95**

CABINET I
3" HIGH
6¼" WIDE
5½" DEEP
GREAT FOR CLOCK & CLOCK CALENDAR KITS
White Plexiglas Case
Specify RED or GRAY Plexiglas Chassis
Chassis Serves As Bezel To Increase Contrast of Digital Displays. Use Gray With Any Color — Red With Red Displays Only (Red LED's with Red Chassis Brightest) **$6.95 ea.**

CABINET II
2½" HIGH
4½" WIDE
5½" DEEP
GREAT FOR SMALLER CLOCK KITS
NEW!
(Ideal for Kit #850 above.)
All Plexiglas Red Chassis, White Case.
Red Chassis Serves As Bezel To Increase Contrast of LED Displays. **$5.95 ea.**

PLEXIGLAS FOR DIGITAL BEZELS
Gray or Red Filter
3" x 6" x 1/8" Approx. Size
95¢ ea
4 for $3.00

XTAL TIME BASE KIT for Clock-Calendar-Alarm Kit **$9.95**
(115 VAC or 12 VDC operation)
Uses 100.800 KHz xtal. For #7001 Kits only.

25k or 4.7k PC Trimmers
6 for $1.00

MM5239 Char. Gen. $1.95 3/$5

IN5400 3A, 50V Rect. 10 for $1.00

LM-309K 5V. Reg $1.25
555 Timer ..... 2 for 1.00
565 PLL ..... .95

TELEX (one ear) HEADSET
2kΩ Impedence $2.95ea.

NEW* FND-359 *NEW
Jumbo .4" 7-Seg LEDs
Red Common Cathode
$.95 ea. 10/$8.50 100/$79.00
(Direct Plug Replacement for FND-70)

7-SEG LED

Common Anode			
MAN-64 AL	RED	.4"	$1.25 ea
MAN-5	GREEN	.3"	.95
MAN-8	YELLOW	.3"	.95
MAN-7	RED	.3"	.95
DL-707	RED	.3"	.95
DL-747	RED	.63"	1.95
FND-510	RED	.5"	1.35
Common Cathode			
HP5082-7702	RED	.3"	1.25
FND-70	RED	.25"	.50
FND-71	±1	.25"	.50
FND-503	RED	.5"	1.35
DL-750	RED	.63"	3.25
DL-704	RED	.3"	1.25
DL-33MM8	RED	.3 x .1"	.49
FND 359	RED	.4"	.95

JUMBO RED LED's
12/$1.00 — 100 for $7.50

Bi-Polar LED's Lights Red One Polarity Green Rev. $1.25

25 AMP FULL WAVE BRIDGE 100 PIV
$1.95 ea. 1N4148 25/$1.00
3/$5.00 1N914 25/$1.00
1N4007 12/$1.00

Form Inexpensive Sockets **MOLEX PINS**
100 for 95¢/1000 for $7.50

Motorola 2N2501 High Speed Switch Silicon NPN 350 MHz hFE 50
8/$1.00 100/$9.00 1000/$55.00

2N2554 PNP Power Amplifier
Stud Mount Case 2 for $1.00
80V. 3A.

Burroughs Panaplex II Display
11 Digit .25" char. gas discharge
$2.95 each 2/$5.00

Mini Slide Switch SPDT ..... 6/$1.00
Reg Slide Switch DPDT ..... 8/$1.00
Push-button Switch N.O. ..... 7/$2.00
Rocker Switch SPDT ..... 6/$1.00

Spectrol 10K Pot
3/8"x3/8"x1/4" high ..... 2 for $1.00

CMOS Micropower PLL
RCA CD4046 AE ..... $1.50 5/$5.

DTL 932 & 937 IC's
6 of each (12) for $1.00

TTL Compatible Reed Relay
IMS cycle time $1.50
15 mA coil SPST N.O.

Opto Isolator House #
By Monsanto 2 for $1.00

Transistors 5 for $1.00

2N404A	PNP	TO-5
2N1991	PNP	TO-5
2N2222A	NPN	TO-18
2N2369	NPN	TO-92
2N3394	NPN	TO-92
2N3704	NPN	TO-92
2N4249	PNP	TO-92
2N4437	NPN	TO-92

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P.O.# _____ PHONE NO. _____

NAME _____

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CITY _____ STATE _____ ZIP _____

QUANTITY	PART NO.	DESCRIPTION	PRICE EACH		AMOUNT	

TOTAL FOR GOODS		
4% STATE TAX (FL Res. Only)		
HANDLING		
TOTAL		

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$1.00 Handling Charge on orders under $15.00.

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ALL MERCHANDISE SUBJECT TO PRIOR SALE

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Orders under $15.00 add $1.00 handling. Fla. res. add 4% tax

S. D. SALES CO.

P. O. BOX 28810 DALLAS, TEXAS 75228

ALARM CLOCK KIT SIX DIGIT LED

Thousands of hobbyists have bought and built our original clock kit and were completely satisfied. But we have received many requests for an alarm clock kit with the same value and quality that you have come to expect from S.D. So, here it is!

THE KIT INCLUDES:

1 Mostek 50252 Alarm Clock Chip
6 Hewlett Packard .30 in. common cathode readouts.
15 NPN Driver Transistors
1 Etched and Drilled P.C. Board set
1 Step Down Transformer
2 Switches for time set
2 Slide Switches for alarm set and enable
1 Filter Cap
4 IN4002 Rectifiers
1 IN914 Diode
1 .01 Disc Cap
15 Resistors
1 Speaker for alarm
1 LED lamp for PM indicator.

$16.50
(COMPLETE KIT)

Why pay MORE MONEY for our competitor's clock that has LESS DIGITS that are SMALLER in size?

Please take note that we use only first run parts in our kits and include ALL the necessary parts. Not like some of our competitors who use retested readouts and chips or who may not even include switches in their kits.

60 Hz. Crystal Time Base

FOR DIGITAL CLOCKS
S. D. SALES EXCLUSIVE!
$5.95

The kit you have been waiting for is here **NOW**, and at an unbelievable price! Thanks to S.D. Sales you can turn that digital clock of yours into a superbly accurate, DC operated, time piece.

KIT FEATURES:

A. 60 Hz output with accuracy comparable to a digital watch.
B. Directly interfaces with all MOS clock chips.
C. Super low power consumption (1.5 Ma typ.)
D. Uses latest MOS 17 stage divider IC.
E. Eliminates forever the problem of AC line glitches.
F. Perfect for cars, boats, campers, or even for portable clocks at ham field days.
G. Small size, can be used in existing enclosures.

BUY TWO FOR $10.00

Kit includes crystal, divider IC, P.C. Board plus all other necessary parts and specs.

ORDERS OVER $15 CHOOSE $1 FREE MERCHANDISE

2102 1K RAM's - 8 FOR $12.95
New units ———— We bought a load on a super deal, hence this fantastic price.
Units tested for 500NS Speed.

MOTOROLA RTL IC'S
Brand new, factory prime. Hard to find, but still used in a variety of projects. (See the RTL Cookbook by Howard W. Sams.)

MC724P-59c	MC780P-89c	MC791P-69c
MC725P-59c	MC785P-49c	MC792P-59c
MC764P-49c	MC787P-89c	MC799P-59c
MC767P-69c	MC788P-49c	MC9704P-89c
MC771P-49c	MC789P-59c	MC9709P-69c
MC775P-89c	MC790P-89c	MC9760P-69c

MV-50 TYPE LED's *by LITRONIX* **10 for $1** *Factory Prime!*

3 DIGIT LED ARRAY — 75c *by LITRONIX*
DL33MMB. 3 MAN-3 Size Readouts in one package. These are factory prime, not retested rejects as sold by others. compare this price! 75c 3 for $2.

SALE ON CUT LEAD SEMICONDUCTORS
Leads were cut for PCB insertion. Still very useable.

1N914/1N4148	100/$2
1N4002 1 Amp 100 PIV	40/$1
1N4745A 16V 1W Zener	20/$1
EN2222 NPN Transistor	25/$1
EN2907 PNP Transistor	25/$1
2N3904 NPN Driver Xstr.	25/$1
2N3392 GE Pre-amp Xstr.	25!$1
C103Y SCR. 800MA. 60V.	10/$1

ALL NEW. UNUSED. SOME ARE HOUSE #

SLIDE SWITCH ASSORTMENT
Our best seller. Includes miniature and standard sizes, single and multi-position units. All new, first quality, name brand switches. Try one package and you'll reorder more. *Special — 12 for $1* (Assortment)

DISC CAP ASSORTMENT
PC leads. At least 10 different values. Includes .001, .01, .05, plus other standard values.
60 FOR $1

UPRIGHT ELECTROLYTIC CAPS
47 mfd 35 V-10/$1 68 mfd 25V-8/$1
Brand new by Sprague. PC leads.

RESISTOR ASSORTMENT
1/4 W 5% and 10%. PC leads.
A good mix of values. 200/$2

1000 MFD FILTER CAPS
Rated 36 WVDC. Upright style with P.C. leads. Most popular value for hobbyists. Compare at up to $1.19 each from franchise type electronic parts stores. *S.D. Special 4 for $1*

FAIRCHILD BIG LED READOUTS
A big .50 inch easy to read character. Now available in either common anode or common cathode. Take your pick. Super low current drain, only 5 MA per segment typical.

			YOUR CHOICE
FND - 510	Common Anode	$1.50 ea. 6 for $7.50	
FND - 503	Common Cathode		

DUAL 741C (5558) OP AMPS
Mini dip. New house numbered units by RAYTHEON.
4 FOR $1

FET'S BY TEXAS INSTRUMENTS — SPECIAL 5 for $1
#TIS-75 but with an internal house number. TO-92 plastic case. N. Channel, Junction type FET.

We do not sell junk. Money back guarantee on every item. No C.O.D. Texas Res. add 5% tax. Postage rates went up 30%! Please add 5% of your total order to help cover shipping.

ORDERS UNDER $10 ADD 75c HANDLING.

S. D. SALES CO.
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DALLAS, TEXAS 75228

SOLVE YOUR TEST CONNECTION PROBLEMS WITH E-Z-HOOK

E-Z Hooks have been designed and field tested throughout the industry to save time and money in commercial electronic production and servicing. The spring-loaded hook attaches firmly, yet so gently it will not damage component – frees hands while testing. Durably constructed and fully insulated to a single contact point assuring true readings. Meets exacting laboratory and space age computer technology requirements. **AVAILABLE IN 10 RETMA COLORS:** Red, black, blue, green, orange, yellow, white, violet, brown or gray. The most unique field-serviceable test connectors available. Fast, safe, sure and trouble-free. **NOW AVAILABLE FROM ANCRONA . . .** the source you can trust for fine quality, industrial-grade electronic components and accessories.

Jumper with X-100W Mini Hooks

Order No.	Length	Price
204-12W*	12"	$1.60
204-24W*	24"	1.60

Specify color.

Jumper with XM Micro Hooks

Order No.	Length	Price
204XM-12*	12"	$1.70
204XM-24*	24"	1.70

Specify color.

MICRO HOOK

XM Micro Hook (1.75" long, <1 gram) for difficult IC Testing. Permits hookups to delicate wires where weight and leverage may damage component. **$.80 ea.**

Specify color. **ORDER P/N XM**

MINI HOOK

X100W Mini Hook (2.25"long) combines rugged construction, miniature size and Finger-eze Hypo Action for all the best test connections. The hook is large enough for component leads, yet small enough to get into tight places. **$.75 ea.**

Specify color. **ORDER P/N X100W**

Jumper, XM Micro Hook to Banana Plug

Order No.	Length	Price
201XM*	32"	$1.40

Specify color.

EXTRA LONG MINI HOOK

XL-1 Mini Hook (5.0" long) combines all the proven features of the X100W with an extra long body. It will make safe, short-free test connections in card racks and through deep wiring nest up to 4". **$1.25 ea.** **ORDER P/N XL-1**

Jumper with XL1 Mini Hooks

Order No.	Length	Price
204XL1-12	12"	$2.80
204XL1-24	24"	2.80

Specify color.

Jumper X-100W Mini Hook to Stacking Banana Plug**

Order No.	Length	Price
201W*	32"	$1.35

Specify color.

Jumper, XL-1 Mini Hook to Stacking Banana Plug**

Order No.	Length	Price
201XL-1*	32"	$1.95

Specify color.

**Specify color.* ***Square hole tip for hooking laterally to leads or vertically over square wire-wrap pins.*

NEW

FROM

PLESSEY

LOW COST INTEGRATED CIRCUITS FOR RADIO COMMUNICATIONS

Plessey SL1600 Radio Communications Circuits are used in all types of military, commercial and amateur radio systems. These same devices are now available in economical, easy-to-use plastic minidip packages. Now you can afford to make extensive use of Plessey circuits in the design of synchrodyne, superhet, SSB and multimode receivers, transmitters and transceivers.

92 PAGE APPLICATIONS MANUAL

Contains Circuit Data, System Design and Technical Data for SL1600 series integrated circuits **$1.95**

A TYPICAL TRANSCEIVER SYSTEM

SSB transmitters and receivers of the same type contain many identical components. Therefore, by a little signal switching, it is possible to make one set of filters and SL1600 devices perform alternately as a transmitter and as a receiver – i.e. as a transceiver. This, of course, results in a real cost saving, both on SL1600 devices (which in any case are relatively inexpensive) and on filters (which are not!). These points are illustrated by the Figure above, a typical SSB transceiver, and also in Applications Manual Appendices B and D.

RF AMP

Low noise, low distortion, amplifiers with integral supply line decoupling and AGC. SL1610 has voltage gain of 10 and bandwidth of 140MHz; the SL1611 has voltage gain of 20 and bandwidth of 100MHz. Both have 50dB AGC range with max signal handling of 250 mV rms. Both offer high input impedance and low output impedance. **SL1610, SL1611 . . . $2.03**

DOUBLE BALANCE MODULATOR

Replaces diode ring modulator, in RF/communications systems up to 75MHz. At 30 MHz, carrier and signal leaks are typically –40 dB referred to the desired output product frequency. Intermodulation products are –45dB with a 60 mV rms input signal. SL1641 is similar for receiver mixer applications w/lower noise figure and power consumption. **SL1640, SL1641 . . . $2.03**

AF AMP, VOGAD SIDETONE

Accepts signals from a low-sensitivity microphone providing an essentially constant output signal for a 60 dB range of input. Constant gain amplifier provides an amplitude-limited output for sidetone in mobile transmitter/receiver applications. 10 lead TO-5 operates from a 6 to 12 volt supply, produces an independent supply line at 4.7 Volts stabilized. **SL1622 . $3.01**

IF AMP

Low noise, low distortion amplifier similar to SL1610 and SL1611 with voltage gain of 80, bandwidth of 15MHz and 20mW power consumption. 70dB AGC range with max signal handling of 250mV rms. **SL1612. . . . . $2.03**

LIMITING AMP/DET

A low noise limiting amplifier for use as an RF clipper, a limiting stage in IF amplifiers, or an RF Compressor in SSB transmitters. Detector detects AM or AGC. Gain of 12 dB when not limiting, upper and lower 3 dB points of 150 MHz and 5 MHz. Limits when input exceeds 120 mV rms. Detected output during limiting is 1 mA. **SL1613. . . . . $2.46**

AGC GEN

SL1620 VOGAD is an AGC generator for use with the SL1630 ir microphone amplifier. Maintains amplifier output between 70mV and 87mV rms over 36 dB range. One second 'hold' period prevents increase of background noise during pauses in speech. **SL1621** is for use in SSB receivers with SL1621, SL1611 and SL1612. Generates a suitable AGC voltage from the detected audio waveform, provides a 'hold' period, is immune to noise interference. Smoothly follows fading HF signals. **SL1620, SL1621 . . . . . $2.58**

AM DET, AGC AMP SSB DEMOD

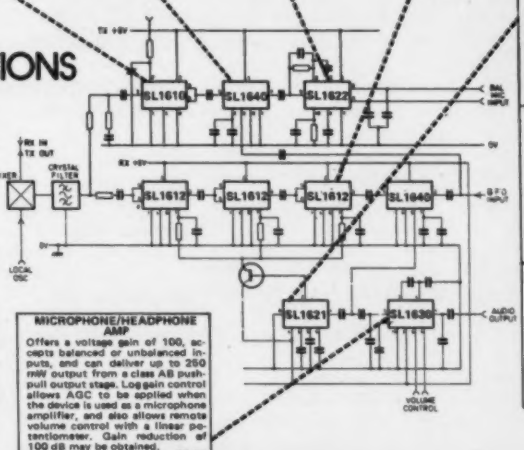
For use in SSB/AM receivers with SL1610, SL1611 and SL1612. Complementary to the SL1621. AGC voltage is generated directly from detected carrier signal independent of depth of modulation. Follows the most rapidly fading signals. SL1610 and SL1612 maintains the output within a 6 dB range for a 90 dB range of receiver input signal. **SL1622. . . . . $3.01**

MULTIMODE DET

Detects AM, FM, SSB or CW, acting as a synchronous detector, a quadrature detector and a product detector with built-in oscillator. Contains a voltage-controlled gain system and a separate audio amplifier capable of driving a single transistor output stage. Does not give an output on broad band IF noise when used following a block filter and a broadband IF amplifier. **SL1624. . . . . $2.81**

MICROPHONE/HEADPHONE AMP

Offers a voltage gain of 100, accepts balanced or unbalanced inputs, and can deliver up to 250 mW output from a class AB push-pull output stage. Log gain control allows AGC to be applied when the device is used as a microphone amplifier, and also allows remote volume control with a linear potentiometer. Gain reduction of 100 dB may be obtained. **SL1632. . . . . $3.86**



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Cat.No. 7A2426 Untested.

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Cat.No. 7A2397 100% good.

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Cat.No. 7A2403

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Cat.No. 7A2309 100% good

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50 for $1.98
Cat.No. 7A 2610 Untested.
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BARREL KIT #35
NEON LAMPS
40 for $1.98
100% good.
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GERMANIUM DIODES
200 for $1.98
Untested
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BARREL KIT #37
1 AMP "BULLETT" RECTIFIERS Untested.
100 for $1.98
Famous style, axatd. voltages, million, axial, includes all types of voltages to 1KV. Cat.No. 7A 2618

BARREL KIT #39
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Cat.No. 7A 2618 100% good.

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Untested
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Cat.No. 7A 2628 Untested.

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Cat.No. 7A 2736 100% good.

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40 for $1.98
15 watt Bendix B-5000 pellet transistors, npn, all-good, purchased from a pretester, have millions of
100% good Cat.No. 7A 2727

BARREL KIT #60
DTL'S IC'S
75 for $1.98
Untested.
This is prime barrel material. Who wants DTL's? 930, 936, 946's. Your gain is our loss. They're marked too. Cat.No. 7A 2728

BARREL KIT #61
POLYSTYRENE CAPS
100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat.No. 7A 2729

BARREL KIT #65
MIXED READOUTS
15 for $1.98
Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate.
Cat.No. 7A 2733 Untested

BARREL KIT #68
2 WATTERS
100 for $1.98
100% good.
Nobody seems to want 'em! So many suppliers don't count, but throw 'em in the barrel. It's a lil' gold mine! All marked. Cat.No. 7A 2735

BARREL KIT #71
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100% good. Cat.No. 7A 2736

BARREL KIT #73
TRANSISTOR ELECTROS
50 for $1.98
It "bugs" us why the factories dump 'em in barrels. We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 7A 2747

BARREL KIT #75
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Cat.No. 7A 2740

BARREL KIT #76
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Untested.
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Cat.No. 7A 2741

BARREL KIT #77
"BROWN" BODY TRANSISTORS
40 for $1.98
G-E D-40 series: has hi-voltage, Darlingtons, hi-current, npn's. Factory line discontinued. Prime tube.
Cat.No. 7A 2742 Untested.

BARREL KIT #79
"RED" BODY TRANSISTORS
40 for $1.98
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Cat.No. 7A 2743 Untested

BARREL KIT #81
SUBMINI RESISTORS
200 for $1.98
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Cat.No. 7A 2748

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LM-340T VOLTAGE REGULATORS
Untested
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BARREL KIT #87
NATIONAL IC BONANZA
100 for $1.98
Factory dumps into barrels. Types 8000, 7400 series, DTL's, ROMs, registers, clock & calc. chips, linears, etc.
Cat.No. 7A 2360 Untested.

BARREL KIT #91
SILVER MICAS
100 for $1.98
Cat.No. 7A 3018
For the first time silver micas so low in price! Axial, red case, variety of physical sizes & values. Big savings from distributor prices. Wt. 1 lb.

BARREL KIT #94
"BUBBLE" READOUTS
12 for $1.98
DL-33B bubble magnifiers. Segs missing. Truthfully so many of 'em we don't care. Untested. 3 oz. No. 7A 3046

BARREL KIT #99
PHOTO ELECTRIC CELLS
10 for $1.98
Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat.No. 7A 3052

BARREL KIT #102
CLOCK CHIPS
5 for $1.98 No. 7A 3038
National is dumping! MM-5316 — what's wrong with 'em, we don't know, but we got barrels. Hobby special. Wt. 2 oz.

BARREL KIT #104
SLIDE VOLUME CONTROLS
10 for $1.98
Cat.No. 7A 3057
Used in hi-fi, volume control maker unloads. Asst. values, what a buy. Worth $1 ea. We've got barrels of 100% material.

BARREL KIT #107
SQUARE OHMS
60 for $1.98 Cat.No. 7A 3096
Factory people are sometimes "unsure" when they topple prime square ohms mix 'em up in barrels. Asst. values watts. Wt. 1 lb.

BARREL KIT #108
TO-5 PLASTIC TRANSISTORS
Cat.No. 7A 3101
40 for $1.98
Includes PNP, NPN, 2N-3638, 2N3641, 2N5000 series, etc. Untested, but guaranteed to a 60% yield.

BARREL KIT #109
TERMINAL STRIPS
150 for $1.98
Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat.No. 7A 3136

BARREL KIT #110
SUPPRESSOR DIODES
50 for $1.98 Cat.No. 7A 3137
Keeps ignition noises out axial. Untested, but the of your equip., car, industrial, etc. Double plug.

BARREL KIT #115
MULTI DIGIT READOUTS
8 for $1.98
barrels of blemished 3, 4 and/or 5 digit readouts to USA for "dump". Untested.
Cat.No. 7A 3138

BARREL KIT #112
MICRO MINI LEDS
40 for $1.98
All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50% or better.
Cat.No. 7A 3139

BARREL KIT #113
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Regulator, sensing and computer circuitry, Axial double plug type. Discontinued factory line. PIV 20 volts, 80% yield. U test 'n save!

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MOLEX SOCKETS
200 for $1.98
100% good.
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Cat.No. 7A 3144

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100 for $1.98
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BARREL KIT #119
MINI SCRS
50 for $1.98
UNBELIEVABLE! TO-92 plastic SCRS in barrels . . . rite from factory. Includes all voltages up thru 300 prv. 7A 3138

BARREL KIT #120
TRIGGER DIODES
25 for $1.98
Type ER-900, same type used to trigger scrs, triacs. Sometimes called "diacs". Untested. No. 7A 3160

BARREL KIT #121
"MINI" MAGNETS
100 for $1.98
Magnet circular and rectangular cuttings from a major maker — For reed switches & micro-circuitry.
Cat. No. 7A 3108

BARREL KIT #123
CD-4002 C-MOS IC
15 for $1.98
mostly good. But we have 250,000. Can never sell 'em out. YOUR GAIN! Their number is CD-5602.
Cat. No. 7A 3217

BARREL KIT #126
UPRIGHT ELECTROS
40 for $1.98
Wide asst. of values from 1mf to 800mf in mixture of voltages. 100% marked 'n good. Why barreled? U-got-a-buy!
Cat. No. 7A 3236

BARREL KIT #127
AXIAL ELECTROS
40 for $1.98
Truthfully the factories (by mixing 'em in barrels) do all of us a favor, WUT A BUY! Asst. capacitios and voltages.
Cat. No. 7A 3227

BARREL KIT #128
MINI DIP ICS
75 for $1.98
Large mfgr dumped 100's of lbs into barrels. Includes 741s, LM-380-8, 702, 567, 555, 556—but who knows? Factory to you. All mixed, you test. Wt. 1 lb.
Cat. No. 7A 3245

BARREL KIT #131
TANTALUM ELECTROS
30 for $1.98
Mixed, marked prime, top grade asst. values, voltages. GE, Centralab, etc.
Cat. No. 7A 3255

BARREL KIT #133
C-MOS IC'S
60 for $1.98
Deliberately thrown in barrels, so we can't test 'em! The famous CD4000 series. How good? Who knows!. Who cares? It's only 3c ea.
Cat. No. 7A 3257

BARREL KIT #138
RIBBON CABLE
30-ft. $1.98
Wire maker closeout (barrels of 'em) 7-conductor #22 yellow jacket. In 5-ft. lengths or longer. 7A 3296

BARREL KIT #140
LAMPS
20 for $1.98
Precision, mini lamp all-metal, panel, with mtg hardware. Lamp maker's overstock. 7A 3297

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10 WATT ZENERS
15 for $1.98
Mfr dumps to prepare for new styling, voltages all over the place. Good yield.
Cat. No. 7A 3298

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DARLINGTON TRANSISTORS
40 for $1.98
TO-92, a Motorola dump, unknown numbers, but high yield to good darlingtons. Retesters didn't get 'em! You will. 7A 3285

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RCA PHONO PLUGS
40 for $1.98
1,000,000 RCA phono plugs for this one. You hi-fi-ers know wut they are . . . 100% material. Look at the price. 7A 3293

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JULY 1976

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	14	7	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	7A	7	7	7	7A	14	14	14	14	14
AUSTRALIA	14	14	14B	7B	7	7	7	7	7	7B	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7A	14	14	14	14	14
HAWAII	14	14	7A	7	7	7	7	7	14B	14	14	14
INDIA	7	7	7B	7B	7B	7B	7	7	14B	14	14	14
JAPAN	14	14	7	7	7	7	7	7	7	7	7	14
MEXICO	14	14	7	7	7	7	7	7	7A	14	14	14
PHILIPPINES	14	14	7	7B	7B	7B	7B	7	7	7	7B	7A
PUERTO RICO	14	7	7	7	3A	7	7	7	14	14	14	14
SOUTH AFRICA	7B	7	3A	7	7	14	14	14	14	14	7	7B
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	14	14
WEST COAST	14	14	7	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

ALASKA	7A	14	7A	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	7A	7	7	7	7	14	14	14	14	14
AUSTRALIA	14	14	14	14B	7	7	7	7	7	7B	14	14
CANAL ZONE	14	14	7A	7	7	7	7	14	14	14	14	14
ENGLAND	7	7	7	7	7	7	7	7	7A	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14B	14	14	14
INDIA	14	7	7B	7B	7B	7B	7	7	7	7A	7A	7A
JAPAN	14	14	14	7	7	7	7	7	7	7	7	14
MEXICO	14	7A	7	7	7	3A	7	7	7	7	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	7B	7A
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	7B	14	14	14	14	7	7B
U. S. S. R.	7	7	7	7	7	7	7	7	7	7A	14	14

WESTERN UNITED STATES TO:

ALASKA	7A	7A	7A	7	7	7	7	7	7	7	7	7
ARGENTINA	14	14	7A	7	7	7	7	7A	14	14	14	14
AUSTRALIA	14	14	14	14	7A	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7	7A	14	14	14	14
ENGLAND	7	7	7	7	7	7	7	7	7	14	14	14
HAWAII	14	14	14	14	7A	7	7	7	7A	14	14	14
INDIA	14	14	14	7B	7B	7B	7	7	7	7	7	7A
JAPAN	14	14	14	7A	7	7	7	7	7	7	14	14
MEXICO	14	14	7A	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	14	7A	7B	7B	7	7	7	7B	14B	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	7B	7B	14	14	14	7	7B
U. S. S. R.	7	7	7	7	7	7	7	7	7A	7A	7A	7
EAST COAST	14	14	7	7	7	7	7	14	14	14	14	14

A = Next higher frequency also may be useful
B = Difficult circuit this period
N = Normal
U = Unsettled
D = Disturbed
DX = Sporadic VHF DX

1976		JULY				1976
SUN	MON	TUE	WED	THU	FRI	SAT
				1 N	2 U	3 D
4 U/DX	5 U/DX	6 N/DX	7 N/DX	8 N/DX	9 U	10 N
11 N	12 D	13 D	14 U	15 U	16 U	17 D
18 D	19 D	20 U	21 U	22 U	23 N	24 N
25 N	26 N	27 N	28 N	29 D	30 D	31 D

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the set . . .

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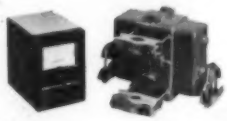

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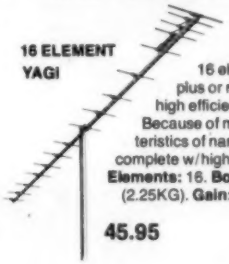
the antenna . . .

16 ELEMENT YAGI



KLM-432-16-5, long boom 16 element yagi, covers 432 MHz, plus or minus 2MHz, uses the proven high efficiency multi-driven feed system. Because of more critical matching characteristics of narrow banding, antenna comes complete w/high performance KLM 1:1 balun. **Elements:** 16. **Boom:** 12 ft (3.65M). **Wgt:** 5 lbs (2.25KG). **Gain:** 15dbd. **F/B ratio:** 20db min.

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